California's Rivers
A Public Trust Report

Prepared for the

California State Lands Commission

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Acknowledgements

California State Lands Commission

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Grateful Appreciation to the following for their review and suggestions:
Betty Andrews, *Philip Williams and Associates;* Trinda Bedrossian, *State Department of Conservation;* Earle Cummings, *State Department of Water Resources;* Steve Evans, *Friends of the River;* Phyllis Faber, *California Native Plant Society;* Richard M. Frank, *State Department of Justice;* Daniel Gorfain, *State Lands Commission;* Richard Hadley, *National Park Service;* Jim Hamilton, *California Trout, Inc.;* Paul Helliker, *California Environmental Protection Agency;* William Jennings, *Committee to Save the Mokelumne;* Todd Keeler-Wolf, *State Department of Fish and Game;* Ed Liu, *U.S. Environmental Protection Agency;* Robert Lynch, *State Lands Commission;* Linda Martinez, *State Lands Commission;* Rick Morat, *U.S. Fish and Wildlife Service;* Nelson Mathews, *Trust for Public Land;* Peter B. Moyle, *University of California, Davis;* John Norton, *State Water Resources Control Board;* Michael Perrone, *State Water Quality Control Board;* Phil Pister, *Desert Fishes Council;* Jack Rump, *State Land Commission;* Dwight E. Sanders, *State Lands Commission;* David Schaub, *State Department of Parks and Recreation;* Jane Sekelsky, *State Lands Commission;* Nancy Stone, *National Parks Service;* Bryant Sturgess, *State Lands Commission;* James F. Trout, *State Lands Commission*

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Acronyms

ADMA	Aquatic Diversity Management Areas
ARB	California Air Resources Board
ARP	Archaeological Resources Protection Act
BLM	U.S. Bureau of Land Management
BMP	Best Management Practices
BOD	biological oxygen demand
BOR	U.S. Bureau of Reclamation
B&W	California Department of Boating and Waterways
CALEPA	California Environmental Protection Agency
CALTRANS	California Department of Transportation
CARCD	California Association of Resource Conservation Districts
CCMP	Comprehensive Conservation Management Plan
CDFFP	California Department of Forestry and Fire Protection
CDMG	California Division of Mines and Geology
CEQA	California Environmental Quality Act
cfs	cubic feet per second
CNDDB	California Natural Diversity Data Base, Department of Fish and Game
COE	U.S. Army Corps of Engineers
CRMP	Coordinated Resource Management Planning
CSSTRF	California Salmon, Steelhead and Trout Restoration Federation
CVP	Central Valley Project
CVRWQCB	Central Valley Regional Water Quality Control Board
CWE	Cumulative Watershed Effect
DDT	dichlorodiphenyltrichloroethane (pesticide)

DFG	California Department of Fish and Game
DHS	California Department of Health Services
DOC	California Department of Conservation
DOM	dissolved organic matter
DPC	Delta Protection Commission
DPR	California Department of Parks and Recreation
DTSC	California Department of Toxic Substances Control
DWP	Los Angeles Department of Water and Power
DWR	California Department of Water Resources
EBMUD	East Bay Municipal Utility District
EC	electrical conductivity
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
ESA	Endangered Species Act
ESU	Evolutionary Significant Unit
FDA	U.S. Food and Drug Administration
GIS	Geographical Information System
IPM	Integrated Pest Management
MCWRA	Monterey County Water Resources Agency
MWD	Metropolitan Water District of Southern California
NCRCD	Napa County Resource Conservation District
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPS	U.S. National Park Service
NPS	Nonpoint source pollution
NRA	National Recreation Area
OPR	California Office of Planning and Research
PAH	polynuclear aromatic hydrocarbons
PCB	polychlorinated biphenyl
PFMC	Pacific Fishery Management Council
PG&E	Pacific Gas and Electric
POM	particulate organic matter
ppb	parts per billion
ppm	parts per million

ppt	parts per thousand
PRC	California Public Resources Code
RWQCB	Regional Water Quality Control Boards
SCS	U.S. Soil Conservation Service
SHPO	California State Office of Historic Preservation
SLC	California State Lands Commission
SMARA	Surface Mining and Reclamation Act
SRA	Shaded Riverine Aquatic Cover
SWP	State Water Project
SWRCB	State Water Resources Control Board
TDS	total dissolved solids
THP	Timber Harvest Plan
TMDL	total maximum daily load
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geologic Survey
WCB	Wildlife Conservation Board
WHR	Wildlife Habitat Relationship System

Foreword

The State Lands Commission holds title to and manages some four million acres of sovereign land held in trust for the people of California. These lands, consisting of coastal and tidelands and all navigable rivers, streams and lakes, became state sovereign or public trust lands when California joined the Union in 1850. Because the Commission holds these lands in trust, they cannot be sold and must be used for water-dependent or water-oriented purposes such as navigation, boating, recreation, fishing, natural habitat and ecological preservation. In managing these sovereign lands under applicable trust principles, the Commission is a trustee or steward, charged with preserving the unique and irreplaceable character of the lands for the use and enjoyment of current and future generations.

This report is another of a series which examines the status of and trends affecting the public trust lands under the jurisdiction of the Commission. The series of reports has three purposes: 1) to mark the status of the public trust resources of California's rivers, lakes, bays, estuaries and tidelands; 2) to explore the likely future of those resources if present trends continue; and 3) to identify means by which such resources can be protected and restored.

The most recent of these reports was published by the Commission in 1991 when it released *Delta Estuary—California's Inland Coast: a Public Trust Report*. The *Delta Estuary* report detailed the historical and current land and water use activities in the region and documented the need for better coordinated and more comprehensive approaches to the management of its resources. The Legislature responded with the passage of the *Delta Protection Act of 1992* which recognized the significance of the Delta region and established a nineteen-member commission to prepare a resource management plan for its protection and preservation.

As the Delta report characterized the region's unique and vital public trust resources and various dependent uses, so does this report for the rivers in California and their watersheds.

It is worth noting that the terms of the trust which govern the management of sovereign or trust lands, whether in the Delta, riverbeds or elsewhere, are found in the statutes and the decisions of the judiciary and collectively comprise what is commonly referred to as

the Public Trust Doctrine. This Doctrine originated in early Roman law and, as incorporated into English common law, held that certain resources were available in common to all humankind by "natural law." Among those common resources were "the air, running water, the sea and consequently the shores of the sea." Navigable waterways were declared to be "common highways, forever free," and available to all of the people for whatever public uses may be made of those waterways.

In California, the Public Trust Doctrine historically has referred to the right of the public to use California's waterways to engage in "commerce, navigation, and fisheries." More recently, the doctrine has been defined by the courts as providing the public the right to use California's water resources: for navigation, fisheries, commerce, environmental preservation and recreation; as ecological units for scientific study; as open space; as environments which provide food and habitats for birds and marine life; and as environ-ments which favorably affect the scenery and climate of the area.

The Doctrine was described by the California Supreme Court in its historic *National Audubon Society v. Superior Court* (1983) decision as "an affirmation of the duty of the state to protect the people's common heritage of streams, lakes, marshlands and tidelands, surrendering the right of protection only in rare cases when the abandonment of that right is consistent with the purposes of the trust."

The *Audubon* decision also stated the principle that the State has "an affirmative duty to take the public trust into account in the planning and allocation of water resources, and to protect public trust uses whenever feasible."

The importance of maintaining irreplaceable public trust resources was eloquently expressed by the State of Oregon Court of Appeals:

> The severe restriction upon the power of the state as trustee to modify water resources is predicated not only upon the importance of the public use of such waters and lands, but upon the exhaustible nature of the resources and its fundamental importance to our society and to our environment. These resources, after all, can only be spent once.
>
> Therefore, the law has historically and consistently recognized that rivers and estuaries once destroyed or diminished may never be restored to the public, and accordingly, has required the highest degree of protection from the public trustee. *Morse v. Oregon Div. of State Lands*, (1979).

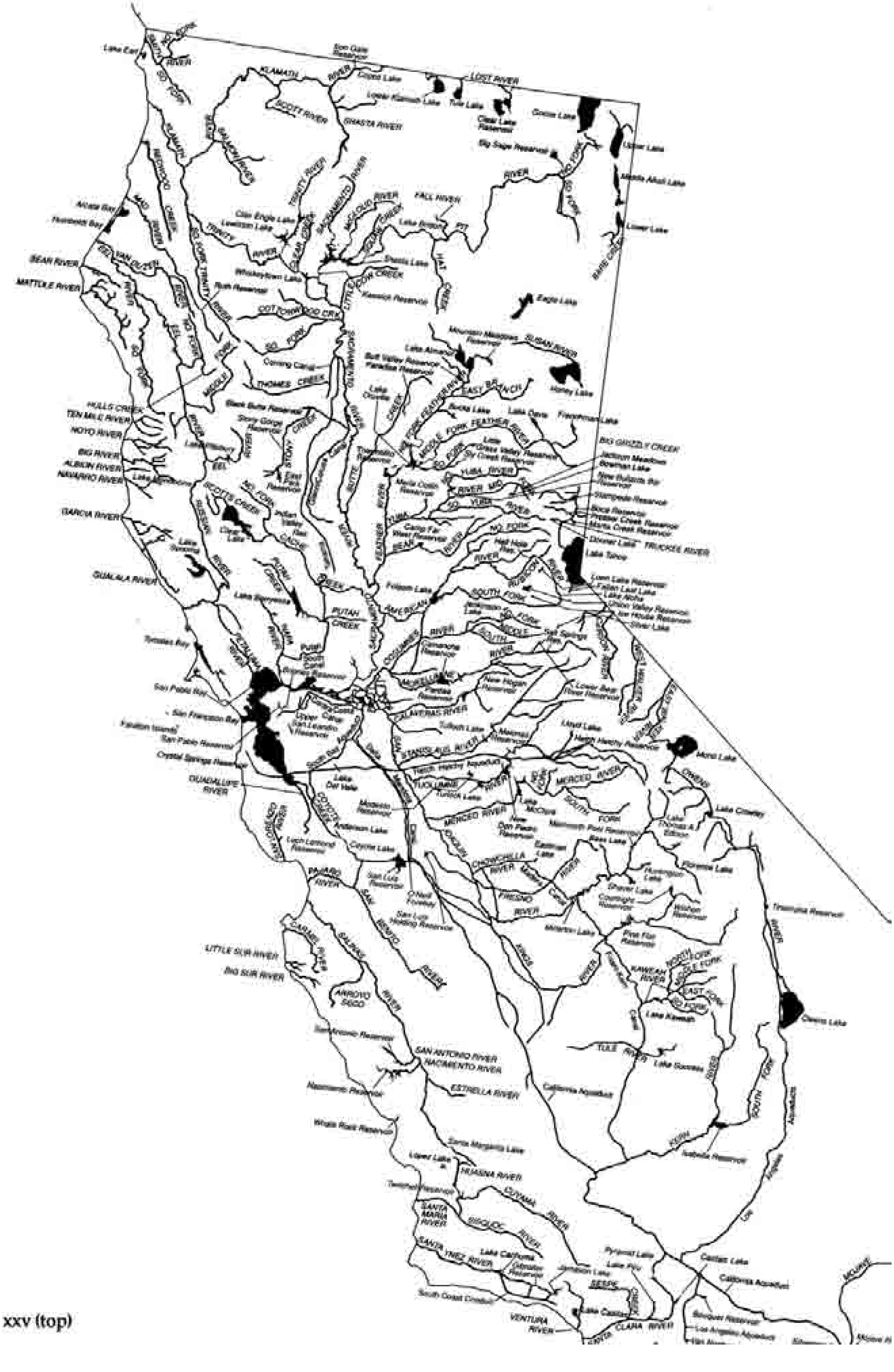
It is with these judicial declarations and admonitions in mind that the State Lands Commission has undertaken its examination of how the public's trust resources have fared since statehood.

As indicated, the subject of this report is the condition of the rivers of California and their watersheds: it documents the causes of their alteration and the nature and extent of their degradation; it identifies the means by which their degradation can be reduced, if not avoided; and it suggests some measures to be taken for their restoration.

The report clearly demonstrates the health of California's rivers to be stressed and their viability as sustainable ecosystems in peril. It should no longer be disputed that there exists an urgent need for state agencies to undertake a comprehensive program of river basin and watershed protection and restoration. Until such a program can be enacted or adopted, individual agencies should undertake to phase out or alter those activities presently permitted or tolerated which are revealed to be degrading the state's rivers and their watersheds; concurrently, such agencies should sponsor and implement actions conducive to the restoration of such rivers and watersheds.

Recently, the prestigious National Research Council released its seminal study and report entitled *Restoration of Aquatic Ecosystems*. In it, the Council urged a new national priority be given to the restoration and protection of the nation's rivers. The Council is the principal operating agency of the National Academy of Sciences in providing services to the government, the public, and the scientific and engineering communities. California should heed the data and analysis provided by the Council and accept the opportunity afforded by the call for a new national priority for the protection and restoration of rivers as ecosystems by establishing its own river restoration and protection program.

The Legislature should schedule public hearings to consider the findings and recommendations of this report and the National Research Council's report on *Restoration of Aquatic Ecosystems*. All federal and state agencies whose activities directly or indirectly affect rivers, together with academic and scientific groups and private sector interests, should be asked to participate in the hearings and to recommend actions for the protection and restoration of California's river resources.


Lake Earl
KLAMATH
RIVER
LOST RIVER
Tule Lake
Goose Lake
SCOTT RIVER
SHASTA RIVER
Upper Lake
Lower Lake
Arcata Bay
Humboldt Bay
BEAR RIVER
MATTOLE RIVER
FALL RIVER
PIT
HAT CREEK
Shasta Lake
Whiskeytown Lake
Keswick Reservoir
COTTONWOOD CRK
Eagle Lake
Mountain Meadows Reservoir
SUSAN RIVER
Lake Almanor
Honey Lake
THOMES CREEK
Bucks Lake
Lake Davis
Lake Oroville
TEN MILE RIVER
NOYO RIVER
BIG RIVER
ALBION RIVER
NAVARRO RIVER
GARCIA RIVER
GUALALA RIVER
Clear Lake
TRUCKEE RIVER
Lake Tahoe
Folsom Lake
AMERICAN
Lake Berryessa
PUTAH CREEK
COSUMNES
MOKELUMNE
CALAVERAS RIVER
Tomales Bay
San Pablo Bay
San Francisco Bay
Farallon Islands
Crystal Springs Reservoir
GUADALUPE RIVER
STANISLAUS RIVER
Hetch Hetchy Aqueduct
TUOLUMNE
MERCED RIVER
Mono Lake
Lake Crowley
San Luis Reservoir
CHOWCHILLA RIVER
PAJARO RIVER
Millerton Lake
LITTLE SUR RIVER
BIG SUR RIVER
CARMEL RIVER
SALINAS
ARROYO SECO
Lake Kaweah
Owens Lake
TULE RIVER
Lake Success
SAN ANTONIO RIVER
NACIMIENTO RIVER
ESTRELLA RIVER
California Aqueduct
Isabella Reservoir
CUYAMA RIVER
SANTA MARIA RIVER
SISQUOC RIVER
SANTA YNEZ RIVER
Lake Cachuma
Pyramid Lake
Castaic Lake
VENTURA RIVER


Honey Lake
Lake Davis
Frenchman Lake
Bucks Lake
Little Grass Valley Reservoir
Sly Creek Reservoir
Jackson Meadows
Bowman Lake
New Bullards Bar Reservoir
Rollins Reservoir
Bear River Reservoir
Camp Far West Reservoir
Hell Hole Res.
Donner Lake
Lake Tahoe
Loon Lake Reservoir
Fallen Leaf Lake
Lake Aloha
Union Valley Reservoir
Ice House Reservoir
Silver Lake
Folsom Lake
Sly Creek Reservoir
Camanche Reservoir
New Hogan Reservoir
Lower Bear River Reservoir
Pardee Reservoir
Tulloch Lake
Lloyd Lake
Melones Reservoir
Hetch Hetchy Reservoir
Don Pedro Reservoir
Eastman Lake
Hensley Lake
Mammoth Pool Reservoir
Bass Lake
Lake Thomas A. Edison
Lake Crowley
Mono Lake
Owens Lake
Pine Flat Reservoir
Kaweah River
Lake Kaweah
Courtright Reservoir
Wishon Reservoir
Millerton Lake
Tule River
Lake Success
Isabella Reservoir
California Aqueduct
San Luis Reservoir
Los Banos Detention Reservoir
Twitchell Reservoir
Santa Margarita Lake
Lopez Lake
Pyramid Lake
Lake Piru
Castaic Lake
Lake Casitas
Gibraltar Reservoir
Lake Cachuma
Jameson Lake
Los Angeles Aqueduct
Silverwood Lake
Mojave River Forks Reservoir
Lake Arrowhead
Big Bear Lake
Lake Perris
Lake Mathews
Lake Elsinore
Lake Skinner
Vail Lake
Lake Hemet
Salton Sea
Coachella Canal
All American Canal
Colorado River Aqueduct
Colorado River
Mojave River
Owens River
Kern River
Los Angeles River
San Gabriel River
Santa Ana River
Santa Clara River
Ventura River
Santa Ynez River
Santa Maria River
Cuyama River
Estrella River
San Antonio River
Nacimiento River
Salinas River
Arroyo Seco
Kings River
Fresno River
Chowchilla River
Merced River
Tuolumne River
Stanislaus River
Calaveras River
Mokelumne River
Cosumnes River
American River
Yuba River
Feather River
Middle Fork Feather River
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Carson River
Walker River
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San Luis Rey River
San Diego River
Sweetwater River
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El Capitan Reservoir
Cuyamaca Reservoir
Sutherland Reservoir
Lake Hodges
San Vicente Reservoir
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Newport Bay
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Irvine Lake
Santiago Reservoir
Van Norman Lake
Stephenson Reservoir
Rattlesnake Canyon Reservoir
South Coast Conduit

xxv (bottom)

California Rivers: Then and Now

1

A river is more than an amenity, it is a treasure.
Justice Oliver Wendell Holmes, *New Jersey v. New York*, 283 U.S. 336, 342 (1931)

From the time when people first arrived in what became California, the state's rivers have served their needs. Over the length and breadth of the state, from the Smith River on the Oregon border to the Sweetwater River near Mexico, from the once-powerful Colorado to the quieter Gualala on the coast, rivers have transported people and their goods, they have given food and water, they have served as convenient borders and as sources of wealth.

This chapter provides a brief history of the relationship between people and their streams. The portrait of the Native Americans' use of the rivers is a painting of vibrant rivers flowing through riparian forests full of life; a picture few Californians today can visualize. Following this early history is a description of the arrival of the Europeans. Much of this history, insight and valuable information on Native Americans' uses of rivers is found in Arthur McEvoy's comprehensive and thoughtful analytical works on both historic and contemporary fishing activities of the Native American. The Natives' benign effects on the rivers are distinguished from the Euro-americans' use of fisheries and of other river uses for mining, navigating, timber harvest, grazing, flood control and water development. The aftermath of these activities and the current status of rivers are described in Chapters 2 and 3.

Native Californian Settlements on the Rivers

When California's first settlers arrived from the north, perhaps 10,000 to 12,000 years ago, they invariably settled near water. Their principal villages were often maintained for a long time. The limits of the territory of the "group" were well defined, comprising in most cases a natural drainage area (Heizer, 1978). But it was the rivers and streams that appealed to the Natives (Kroeber, 1925); these rivers

included the Klamath River of the Northwest, the Sacramento River and its tributaries in Central California and the Colorado River. The South Coast area is the exception, with an ocean orientation of the native people.

So fertile were the habitats where they hunted, gathered and fished that the most densely populated lands anywhere in North America were the valleys and coastal areas of California (Cook, 1976). The natural diversity, in combination with the geographical diversity, contributed to the remarkable variety and extent of the Natives civilization (McEvoy, 1986). The best estimate of the Indian population which existed prior to colonization and settlement by Euro-americans is about 310,000 (Cook, 1976; McEvoy, 1986). The Indian population numbers were lower in the deserts and high mountains (Kroeber, 1939) as would be expected. Overall California supported a higher population density of Indians than any other place on the continent north of central Mexico (Kroeber, 1925; McEvoy, 1986).

Native Indians depended mostly upon plant sources for food, especially acorns, but fish, shellfish and game were also important, depending upon local conditions (Kroeber, 1935). The Indians with the most sophisticated social organization appear to be those who relied upon fisheries, such as the Indians of the lower Klamath River in the northwestern part of the state (Kroeber, 1925; McEvoy, 1986).

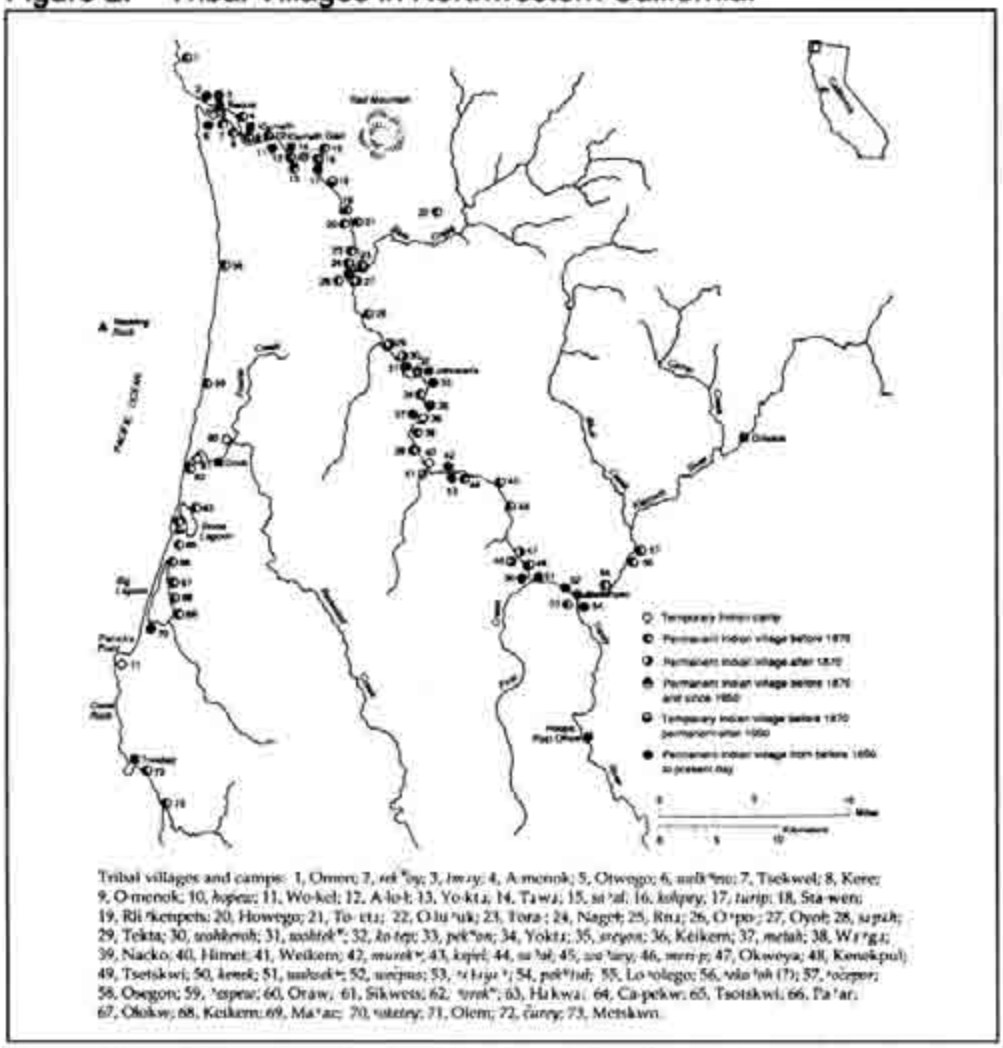
Seasonal variation provided abundant game, fish and plants to the Native Americans. Riparian forests and river valley marshes provided many plants used for food, clothing, implements, baskets, and other objects. The Pomo, renowned for their basketry, used resources of the Russian River and coastal rivers in what is now Sonoma and Mendocino Counties. Their basket making made use of the strong yet pliable branches of the sandbar willow, a common riparian species of the area's rivers and streams (Tripp, 1984).

Chowchilla, Cosumnes, Cuyama, Gualala, Huasna, Kaweah, Klamath, Mattole, Mohave, Mokelumne, Napa, Noyo, Otay, Petaluma, Shasta, Sisquoc, Truckee, Tuolomne and Yuba are river names derived from the Native Americans (Kroeber, 1925).

Northwest Settlements

The rivers became especially important for the tribes that took up residence in the northwest part of the state. The old Hokan-speaking tribes of Karok, Chimariko and Shasta and the newer Athabascan Tolwa, Hupa, Mattole, Wailaki and Algonkin Yurok considered the rivers central to their existence. These tribes' life cycles, religions and wars focused on the rivers and, particularly, the salmon in those rivers. Even their language focused on the river: Karok means "upriver people," while Yurok means "downriver people" (Figure 2).

Figure 2. Tribal Villages in Northwestern California.

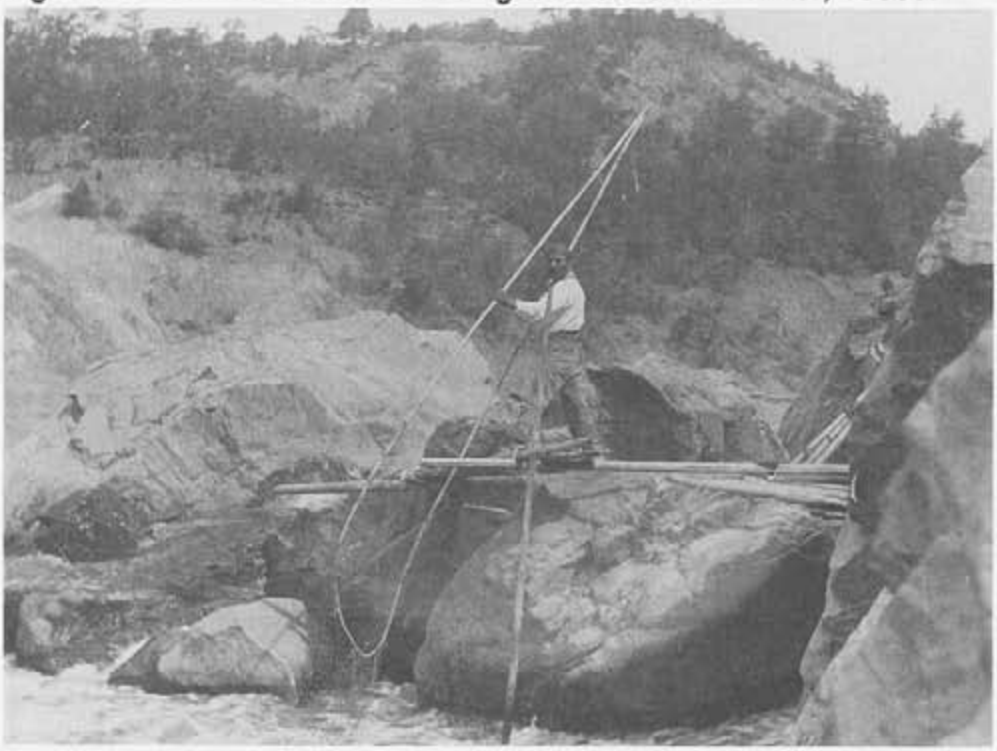


Source: Heizer (ed.) *Handbook of North American Indians*, Smithsonian.

The cultures of these two tribes were, in many ways, the least Californian of our native tribes, reflecting more closely the Northwest Coast cultures of coastal Oregon and Washington. Environmentally the northwestern part of California differs from the rest of state in that it has a greater rainfall (up to 100 inches annually), it is covered almost completely with dense timber (redwood or Douglas-fir forests) and had some of the best fish resources in California. These factors, combined with their cultural heritage, made these people predominately fishers rather than hunters or gatherers. Permanent villages were established almost exclusively along the major salmon streams.

While the total population of these northern tribes was not large, and the overall density (about 4.25 people per square mile) was not high, it cannot be said to have been sparse in a normal sense, since settlements were very dense along the streams. There were obvious effects of the ecology on their tools and techniques, with a high development of fishing gear such as spears, nets, dams and weirs.

Figure 3. Native American Fishing on the Klamath River, 1880s.



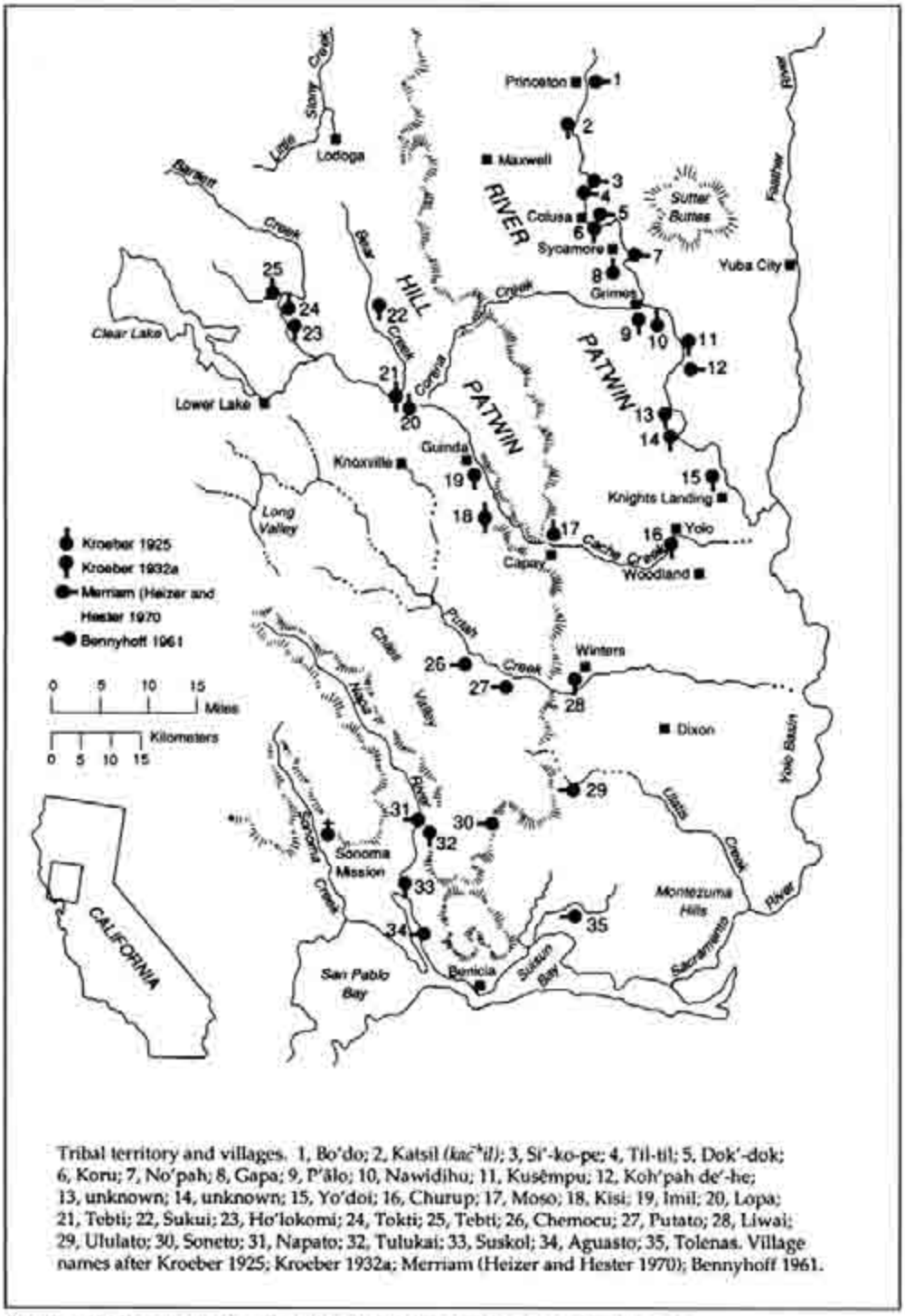
Courtesy of NAA Smithsonian.

The somewhat unpredictable, cyclical nature of the salmon's annual migrations over the centuries profoundly influenced Yurok life. Religion, lore, law and tribal technology all evolved from the Indians' relationship with their fishery resources (Lufkin, 1991).

The effects of the environment on the Native population size is not well understood. For reasons not entirely clear, the tribal groups in this part of California seem to top out at about 3,000 individuals. Possibly the superabundance of fish in some areas was more apparent than real. For example, the Yurok at the mouth of the Klamath would appear to have almost unlimited fish resources, but failed to exploit them. One reason might be that full utilization of the resource would have deprived upstream tribes, who probably would have initiated some action to redress the balance.

The extreme crowding of these rivers may have had something to do with the litigious characteristic of the Northwestern California societies; for example, one was entitled to use any boat beached on the river bank in order to cross a stream, but one was liable for the value of the boat if anything happened to it while in use. These tribes also had a view of land "ownership" that was more similar to their European successors than did tribes in other parts of the state.

Figure 4. Tribal Villages in Central Valley.



Tribal territory and villages. 1, Bo'do; 2, Katsil *(kac'il)*; 3, Si'-ko-pe; 4, Til-til; 5, Dok'-dok; 6, Koru; 7, No'pah; 8, Gapa; 9, P'älo; 10, Nawidihu; 11, Kusêmpu; 12, Koh'pah de'-he; 13, unknown; 14, unknown; 15, Yo'doi; 16, Churup; 17, Moso; 18, Kisi; 19, Imil; 20, Lopa; 21, Tebti; 22, Sukui; 23, Ho'lokomi; 24, Tokti; 25, Tebti; 26, Chemocu; 27, Putato; 28, Liwai; 29, Ululato; 30, Soneto; 31, Napato; 32, Tulukai; 33, Suskol; 34, Aguasto; 35, Tolenas. Village names after Kroeber 1925; Kroeber 1932a; Merriam (Heizer and Hester 1970); Bennyhoff 1961.

Source: Heizer (ed.) *Handbook of North American Indians*, Smithsonian.

Sacramento and San Joaquin Rivers and Delta Settlements

California's rivers were important to the tribes living along the Sacramento and San Joaquin rivers, and the Delta which formed where the two come together. Vast areas of grassland, fair quantities

of variable woodland and chaparral, combined with rivers to provide one of the richest habitats in California. The woodland/chaparral provided deer, vegetables and the staple acorns; the grasslands provided antelope; and the rivers provided salmon and other fish and the large gallery forests along the riparian corridors provided more acorns.

The dense populations fostered by such a favorable environment led to stronger kinship groups than other parts of California, with individual status often being ascribed at birth. Both strong matrilineal and patrilineal systems developed in the area, often to the confusion of later anthropologists (Heizer and Whipple, 1951).

The Native lines of communication followed the large streams (Figure 4). For example, the relationships of the Nisenan were to the north and northwest in the Sacramento Valley, while the San Joaquin portion of the Great Valley was unknown territory to them. In the same way, their neighbors to the south, the Eastern Miwok, had communication lines to the south and into the Sierra, but very little to do with the north. Fishing was important to both these groups, if not as central as it was to the Northwestern tribes. Salmon, sturgeon and lampreys were taken, primarily in nets. Dip nets, seines, set nets and casting nets were all used, often in conjunction with the reed raft.

Sierra Settlements

The rivers had less importance for the early dwellers in the Sierran foothills and for the southern San Joaquin Valley. There was too little water, and the streams were often only intermittent. Many of these groups migrated seasonally throughout their range, camping near the rivers when they were running full, and working the upland drainage as hunters in the summer and fall when the rivers were low.

Desert Settlements

In the southern deserts, as well, rivers were generally not central to the tribal lifestyle, with one important exception. All along the Colorado River several tribes lived permanently on the river's edge, and used its fish resources as an escape from the harsher life of desert hunter-gatherers. It is clear that the Yuma, Chemehuevi and Mohave lived better than their neighbors who had no access to the river. In addition to the fishing practices of these tribes, the use of the river flood plain for crops gave them a food surplus that allowed for trade with groups as far away as the Hopi, in central Arizona.

Central and South Coast Settlements

The tribes of the Central and South Coast used the mouths of rivers and streams as harbors, but otherwise turned more to the sea than to the inland waters. The immediate predecessors to the

Chumash were known from midden remains to take salmon from these coastal streams, but the fishing pressure appears to have been too much for the fish populations at the edge of their range and by the time the Europeans arrived the Chumash were oriented more towards the sea and less toward their rivers.

Exploration and Exploitation—The Coming of the European

The Spanish Padres and Conquistadors came by sea or over land from Mexico, and they found the east-west running rivers more of a barrier than a help in their primarily north-south travels. Francisco Ulloa proved California was not an island, and discovered the mouth of the Colorado in 1739. Juan de Offate had explored a route from Santa Fe to the Colorado, and downstream as far as the Gila River in 1604.

Later the Spanish established what became known as the "Old Spanish Trail," which left Santa Fe and went north, crossed the Colorado River upstream of the Grand Canyon, and entered California below Death Valley. The trail followed the course of the Mojave River, and entered the Los Angeles basin over Cajon Pass. Major exploration of California's principle inland rivers did not begin until after the mission of San Jose and Presidio of San Francisco were founded.

European exploration and use of the Sacramento-San Joaquin Delta waterways began early, but grew slowly. Father Juan Crespi and Don Pedro Fages stood on the top of Mount Diablo and described the meeting of what are now called the Sacramento and San Joaquin rivers in 1772. Explorers from the new Presidio at San Francisco in small boats reached the mouth of the Sacramento in 1776, and called it the San Roque. In 1808 Lieutenant Moraga ascended the river to the mouth of the Feather River, which he called the Sacramento. He then went overland from the Sutter Buttes and made it back to the river near Stony Creek. He gave the Sacramento another name, the Jesús Maria.

Larger vessels began exploration in 1811, as Fathers Abella and Fortini took a short trip up the "northern river of San Francisco," and then explored the mouth of the San Joaquin River. Land expeditions by the Spanish Fathers and soldiers through 1820 wandered about Montezuma Slough, up the Sacramento as far as present-day Redding, and along the southern edge of the Delta to where Stockton now stands.

Other Europeans entered the picture soon thereafter. The Russians, under Captain Kotzebue, sailed up the Sacramento in 1824. The British navy sent H.M.S. *Sulphur* in 1837, which produced the oldest surviving chart of the lower Sacramento. The Americans were represented by Jedediah Smith, who walked along the upper Sacramento in 1828, believing it to be the legendary Buenaventura River,

which many thought flowed west from the Rocky Mountains to the Pacific.

Hunters followed the explorers. By 1820, British and French trappers appeared in the Delta, often taking their pelts to Yerba Buena Cove, but they only left some scattered place names, such as French Camp, in the Delta proper. But in 1832 a more permanent change was brought about by the trappers. A Hudson's Bay Company party, led by John Work, came down the Sacramento River in that year and returned up the river the following year. They brought malaria with them, and in and near the wetlands of the valley the results were fatal to the Native inhabitants. Within four years over 75 percent of the Patwin were dead, the Bay Miwok had disappeared, and the Plains Miwok had lost over 80 percent of their people. By the time the Europeans decided to try settling in the Delta, there were no Natives to displace.

Real river commerce depended on settlement, and the Delta was surrounded by settlements in the early 1840s. Dr. John Marsh was first, settling at the foot of Mount Diablo in 1837. Then John Sutter built New Helvetia on the American River in 1841. Juan Peña and Juan Vaca settled Lagoon Valley, near present day Fairfield, in 1842. The Berryessa brothers obtained a grant of land on Cache Creek in 1843. And Charles M. Weber settled first at French Camp in 1844, then founded Stockton on the San Joaquin River a few years later.

The Sacramento River had more traffic than the San Joaquin because of upriver settlements by Peter Lassen, John Bidwell, William Knight and the Wolfskill clan. When Sutter bought out the Russians at Fort Ross in 1841, the purchase included a sailing launch, renamed the *Sacramento*. This little vessel was the first to carry on regular service between New Helvetia and Yerba Buena, now Sacramento and San Francisco. The trip usually took about two weeks, round trip.

Although major ocean-going sailing ships regularly docked at Sacramento, and later at Stockton, everyone realized that the rivers needed steam power. The "steam era" began on a summer day in 1847, when the Russian bark *Nasednich* dropped anchor in Yerba Buena cove and began unloading her "general cargo." Out of her hold, in several pieces, came a 37-foot steamboat, the *Sitka* (sometimes called "Little Sitka"). She was consigned to an early merchant, William Leidesdorff, who had her quickly assembled. He tested out his purchase on San Francisco Bay for awhile. But on November 29, 1847, the *Sitka* headed upriver for New Helvetia. The trip was not an unqualified success. It took six days, seven hours to reach the upriver destination, and on the return trip she was beaten to Benicia by an oxcart. Beaten by four days, in fact. While this was an indication of their demise, sailing ships were not yet threatened.

All That Glitters. . . .

But it was gold that really brought the world to California, and the gold was in the rivers, at least at first. The early settlers had brought disease, and had displaced some Indians, but the gold miners essentially eliminated those who were left.

Particularly in the northwest part of the state, where the rivers were so important to the Natives, bitter conflict erupted. The Chimariko, for example, for a short while got the upper hand. But the whites ultimately:

> . . . taught (them) that they must not presume to discuss with American miners the question of the proper color for the water in the Trinity River. [The Chimariko] were hunted to the death, shot down one by one, massacred in groups, driven over precipices. . . In the summer of 1871. . . there was not an Indian left. The gold was gone too, and the miners for the greater part, and amid the stupendous ripping-up and wreck of the earth which miners leave behind them, in this grim and rock-bound canyon. . . one finds himself indulging in this reflection: The gold is gone, to return no more; the white man wanted nothing else; the Trinity now has nothing but its salmon to offer; the Indian wanted nothing else (Powers, 1877a).

Figure 5. Hydraulic Mining in the Sierra Nevada.

Courtesy of Sacramento Archives and Museum Collection Center.

In the Sierra, too, it was the water that attracted the gold seekers. Every river, stream and rill was buried under the hordes that came from all corners of the globe, settling on the bends, bars and flats of the Mother Lode. When the panning died out, the miners

turned to dredges and then to hydraulic mining, which used the waters of the rivers to wash the mountain sides and turned the rivers into giant sluice boxes that literally carried the soil of the mountains downstream, filling river beds with tragic consequences.

Hydraulic Mining

Hydraulic mining involves directing a high-pressure jet of water onto an exposed placer deposit (gravel, sand or silt) and running the sediment through sluices to remove the gold (Figure 5). From the 1850s until it was prohibited in California by court decisions in 1884 (*People v. Gold River Ditch and Mining Co.*, 66 Cal. 138 1884), hydraulic mining was intensively practiced on placer deposits in the Sierra Nevada, especially in the Yuba, Feather and American river drainages (Yeend, 1974).

Large portions of mountains were washed away, leaving canyon-like landscapes, some of which are now state historic parks (Malakoff Diggins and Columbia). The sediment was washed through sluices and thence into steep canyons, from which the sediment was readily flushed by high flows (especially the record floods of 1862) into lower reaches of the rivers in the Sacramento Valley. This influx of hydraulic mining debris increased the sediment load of the rivers beyond their transport capacity, resulting in extensive deposits of tailings in the Sacramento Valley. The "debris plain" of the Yuba River was particularly noteworthy, covering over 40 square miles. As river channels filled with sediment, navigation was affected and rivers flooded farmland, inundating many fields with fresh deposits of hydraulic mining debris. Agricultural interests successfully halted the practice of hydraulic mining in the courts.

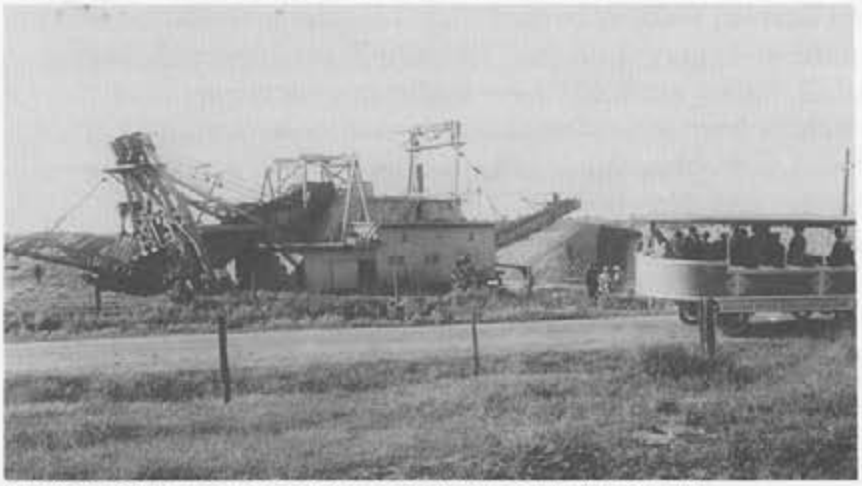
The passage of this wave or "slug" of sediment through the Yuba River was well documented by Gilbert (1917) and Adler (1980). At Marysville, aggradation had peaked and the bed began incising by 1905. Stabilization of the bed of the Yuba River continued for decades, influenced in large part by channel training works and the construction of Englebright Dam in 1940 upstream of the debris plain (Kondolf, 1988).

Dredger Mining

The flood plains of many California rivers display a distinctive pattern of parallel ridges and swales, with relief commonly ranging up to 40 feet. These features are the tailings piles of gold dredgers, large floating barges that reworked alluvial deposits for gold (Figure 6). The dredgers operated in temporary lakes, and created a stratigraphy in which fine sediments were overlain by coarse sediments. The resulting ridges consist of well-drained cobbles and gravel on which vegetation is typically unable to establish. In between the ridges, near-surface water tables may support riparian plant species.

The Yuba River debris plain has been worked repeatedly by dredgers, producing a distinctive landscape of gravel ridges many feet high. The flood plains of the Feather, American, Tuolumne and other major rivers draining gold-bearing terrain have also been dredged.

Figure 6. Gold Dredger on the Sacramento River.



Courtesy of Sacramento Archives and Museum Collection Center.

Fishing and Fisheries

The Beginning - Native Americans

Native Americans had the ability to change their world by significantly influencing the natural environments they inhabited and the resources they utilized, including fisheries. Their dependence on the fisheries in nearly every way required conservation of the resource. Evidence suggests they practiced active management to protect against resource depletion through exploitation and the vagaries of weather (McEvoy, 1986). Tribal conservation practices, such as removing fish dams to allow the fish to spawn up-river ensured that stocks would remain plentiful (Lufkin, 1991). Where fisheries were an important part of the resource base, such as on northwest rivers, Indian culture included especially elaborate social or legal controls over fishing, as well as major ceremonies, rituals, and other spiritual traditions centered on the rivers and their fish (Kroeber, 1925; Roberts, 1932).

Natives fished over most of the state, from lakes, rivers, streams and the ocean. Salmon was the predominant catch on the larger rivers from Monterey Bay northward. Lamprey eels and sturgeon were also caught, especially in the North Coast region (Kroeber, 1925). Delta Indians fished a number of warm water fish, including the Sacramento perch, thicktail chub and hitch, which inhabited the lakes, marshes and backwater sloughs of the Delta and valley lowlands (Schulz and Simons, 1973). On the Colorado River,

the native fishes were rather bony and mushy-fleshed, but were caught and eaten by the Yuma and Mohave people (Kroeber, 1925).

Fishing technology among California Native people included a variety of gear and practices. Various modes of netting and entrapment were widespread and common, including gill nets, seining (encircling) nets, dip nets, weirs (dams) and traps (Kroeber, 1925; Kroeber and Barrett, 1960; Roberts, 1932). Harpoons were also used throughout the state except on the Colorado River, where the water was too turbid. Often, scaffolds were built out over rivers, from which dip nets or harpoons were used. In smaller streams and pools, poison derived from plant materials, such as the California buckeye was sometimes used (Kroeber, 1925). Hook and line fishing was known, but seems to have been employed relatively infrequently (Kroeber, 1925; Schulz and Simons, 1973). Aboriginal fishers also shared with their successors fishery management problems that are still challenging today: coping with natural fluctuations in resources, controlling fish harvest and promoting economic viability at the same time. Many Native American salmon fishing groups worked at the southern-most limit of the habitat, where small climate changes can drastically alter the size of salmon runs from year to year. In southern coastal California, moreover, environmental change forced some Indian villages to change their fishing strategies and others to abandon fishing altogether.

The First Salmon Fishery

Salmon was a large portion of the diet of the Yurok, Karok, and Hupa (Hoopa) peoples of the lower Klamath and Trinity rivers. As a consequence, the salmon fishery of these northwestern Indians was an integral part of all aspects of their culture, including religion, economics and law (McEvoy, 1986). "First Salmon" ceremonies to herald a new season were held in the spring or fall (Kroeber, 1925). These ceremonies were to ensure the bounty of the salmon. The ceremonies, usually with dance, were the most elaborate in the Northwest, where salmon was of great importance.

Other great ceremonies and dances accompanied the establishment each year of major fishing sites on the Klamath. At certain narrow spots on the river, huge weirs of posts and branches were placed across the river to block salmon passage so they could be netted or trapped (Kroeber, 1925). Such weirs were major community projects, as was the dip netting at the pools below Ishi Pishi Falls (Rogers, 1932). A huge weir was placed at Kepel on the Klamath below Weitchpec at the confluence of the Trinity River. This weir took 60 people 10 days to build and the accompanying dance carried on for weeks after (Kroeber, 1925).

In addition to group fishing efforts, individuals or families held ownership rights to fishing places on the river. These rights

were well respected and could be sold or passed down in families (Rogers, 1932). No new fishing places could be established at or below existing ones; this controlled the number of fishing sites (Kroeber, 1925).

There have been efforts to estimate the size of the salmon harvest of the Native Americans prior to the coming of the Europeans. One example, from the Bureau of Indian Affairs, conservatively places consumption in the Klamath-Trinity basin at 36,000 chinooks, or some 50,000 pounds, each winter. Other estimates for the same area run as high as 2 million pounds per year (McEvoy, 1986). Of these and other estimates it is interesting to note that they approximate the highest yields that the same regions ever produced commercially under the Euro-americans' hands. On the Klamath "the greatest run of salmon known to white men" produced only 1.4 million pounds of salmon, in 1912, while yields from the Sacramento peaked at roughly 10 million pounds per annum between 1880 and 1883 (Snyder, 1931). Thus the evidence suggests that the Native Americans' harvest of fish was at least at comparable levels with the Euro-american commercial fishers who followed them. In spite of this obviously significant pressure on the resource, the Native Americans sustained their yields for centuries.

Natural climatic variation must have resulted in poor salmon runs occasionally, and Indian tales and legends refer to such times (Rogers, 1932). However, McEvoy's (1986) analysis of Native American fishing concluded that Indians developed and maintained a productive salmon fishery that divided the resources among many peoples and was sustainable in the long term. This is in dramatic contrast to the Euro-american societies which followed.

The End of the Original Fishery

The decimation of the Native Americans parallels the subsequent decline of fisheries which followed European settlement. It took 65 years from the establishment of the first Spanish mission, in 1769, to render the Native population in the coastal strip between San Diego and Sonoma to 75 percent of its former numbers. The Euro-american miners and farmers who came in later decades wiped out wholesale any Natives they found. "Between 1845 and 1855 alone, two-thirds of the remaining Natives lost their lives" (McEvoy, 1986). When the gold fever ended so had the Native Americans—only 50,000 still lived (McEvoy, 1986). By 1900 their population was estimated at about 16,000 (Kroeber, 1925). Stephen Powers wrote in 1871:

> Never before in history has a people been swept away with such terrible swiftness, or appalled into utter and unwhispering silence forever, as were the California Indians. . . let a tribe complain that the miners muddied

their salmon streams, or steal a few pack mules, and in twenty days there might not be a soul of them living (Powers, 1872a).

The European's impact on the Native population mirrors the exploitation of the state's natural resources. Most California Natives "simply could not get out of the way. Because they had spread their economies so broadly over their habitats and adjusted their harvesting so closely to capacity, the sudden interruption of their seasonal rounds at any point brought privation" (McEvoy, 1986).

The Wintu Fishery

For the Wintu tribe, conflict over salmon streams usually was not a direct conflict over the use of salmon. Gold mining and logging damaged the salmon streams to the point where the Native Americans could no longer support themselves on the diminished harvest. This, and being pushed into the unproductive surrounding mountains, away from the water, was the core of conflict. By the 1870s, mining had rendered the American and Feather rivers all but useless for salmon. Only the Little Sacramento and McCloud rivers remained of all Central Valley streams as viable spawning grounds, and the Natives were only allowed near the McCloud. There a band of Wintu were still operating a successful subsistence fishery in August of 1872, when a U.S. Fishery Commission biologist found them. The biologist, Livingston Stone, had arrived to collect salmon eggs for the commission. His initial meetings with the Natives were not auspicious, but he developed a relationship with the tribe where he could take the eggs as long as the Natives got the fish. Stone believed very soon that the cooperation of biologists and Indians was necessary if the salmon was to survive as a resource. President Grant reserved, for government use, 280 acres as a fish hatchery. In 1877, a small garrison of soldiers arrived to prevent friction with the settlers who, by then, were arriving in larger numbers. The Native Americans and the government worked well together, supplying eggs and fry to the East Coast, Sacramento and abroad. Stone's arrangements protected the heart of the system very well, but progress on the lower river soon caught up with him. On August 7, 1883, where they were used to counting 6,000 to 8,000 fish jumping every hour, after the fall run had begun as usual, he could see no more fish in the river. Several miles below the station, at the

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mouth of the Pit River, the Central Pacific Railroad had begun blasting to clear a bed for its line. Stone was convinced that, although some of the workers had been blowing charges in the river itself and collecting the dead fish, the blasting by Central Pacific had driven the fish back. There were no more fish for the rest of the season. The hatchery itself did not reopen for five more years, and when it did, the Wintu fishery was dead. They held their last communal fish drive at Baird "about 1886." The historic fish hatchery now lies at the bottom of Shasta Lake.

Source: Case law and McEvoy, 1986.

The Yurok, Hupa and Karok of the North Coast region survived far better than other groups in the state (Kroeber, 1925). Further, these people managed to hang on to their historic fishery, in contrast to the complete disruption of native economies and societies which occurred elsewhere. McEvoy (1986) postulates that the inaccessibility of the area in combination with the tight and well-ordered society of the Natives effectively delayed the onslaught of white culture and economic development in the area.

North Coast Indians ultimately faced tremendous conflicts with white immigrants after 1850. Many were killed, lost their land, or contracted disease (sources reviewed by McEvoy, 1986).

Navigating the Klamath

Fishing on the Klamath River has occurred since the earliest days of California. Native American Indians used seine nets and other devices to fish for salmon, which was a staple of their existence. In 1855, President Pierce created the Klamath River Indian Reservation which encompassed lands within one mile of either side of the river and upstream for a distance of 20 miles. After the devastating floods of 1861, the United States Bureau of Indian Affairs relocated the local Indians to a newly created Smith River Reserve. Longing for their native lands, the Indians returned to the Klamath River basin. In 1876 President Grant created the Hoopa Indian Reservation at the confluence of the Klamath and Trinity rivers.

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As in many other areas of the nation and the state conflict arose between the Indians and whites who wanted to settle on Indian lands. Squatters kept moving into the Klamath Valley, claiming the army had abandoned the reservation in 1862. And the army kept sweeping them out of the Native lands. R. D. Hume, a salmon entrepreneur from Oregon with the idea of packing salmon out of the river, precipitated (1887) the following events: Hume was prepared to fish without permission—the Interior Department had denied his offer to buy land along the river and a request for a 10-year lease on fishing rights. Crossing the bar in a light steam tug prepared to build a floating cannery in the estuary, Hume, armed, warned the commander of the local army garrison not to interfere. To supplement his own fishing crews, he purchased fish from the Yurok with goods stored aboard his tug. The Yurok, however, had worked hard to clear the estuary bottom for their nets, and complained to the local agent and the Army that Hume's operation "very much" disturbed their own fishing rights (Dodds, 1959).

The U. S. Attorney General received the complaints and ruled that, since the waters were stipulated navigable by the state, the Indians had no exclusive right to fish them, but only a right to fish in common with the public at large. Whether or not the lower river was "Indian Country" and whether Hume could be excluded on that basis were questions "clearly justiciable in the appropriate courts at the suit of the Indians themselves. . . ." At that point the army seized Hume's tug with its store under a law prohibiting unlicensed trading in "Indian Country." (Humboldt Times, June 9, 1887)

The "appropriate court"—the federal district court in San Francisco—decided the matter in the case of *United States vs. Forty-Eight Pounds of Rising Star Tea, etc.* The government's prosecution was badly handled: The U.S. attorney did not appear in court to present Interior Department's side of the issue, and the local agent for the Native Americans was the government's only witness. The judge agreed with Hume that the Klamath was by law a navigable river, and that the land ceased to be a reservation when it was abandoned in 1862. On appeal, the judgement was upheld. Hume freely packed and traded salmon (35F 403, ND Cal 1888).

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Hume never realized a profit, and after a few years, sold out to Bomhoff's Klamath River Packer's Association. The vulnerability of the Natives' fishing rights had been shown, and demands for land along the lower river became more insistent every year. To circumvent the *Rising Star Tea* decision, and on the basis of a report from the Interior Department, President Harrison extended the Hoopa Valley Reservation down to the ocean in 1891 (Executive Order, October 16, 1891). This act secured the Indians' rights to lands surrounding the river and their ability to fish in it.

Source: 35F 403, ND Cal 1888 and McEvoy, 1986.

For several decades in the late 1800s numerous congressional bills and treaties were attempted to create and maintain some sort of reservation for Klamath and Trinity river-dwelling Indians. At the same time legal questions were being addressed regarding Native American fishing rights on the river, mainly as a result of competition with white commercial fishing interests (Pierce, 1991a and b).

The rights of the Native Americans of the extended Hoopa Valley Reservation, although having been recognized as preferential for the Klamath River salmon fishery, nonetheless remained undefined and increasingly controversial during the early decades of this century. Until the state's closure of the river to commercial fishing in 1933, the Yurok were either employed in several canneries or supplied those canneries with salmon. The Yurok gradually began using modern boats and gill nets and became commercial fishermen. "Between 1915 and 1928, an average of 82 boats harvested some 52,000 chinooks, or about 725,000 pounds of salmon each year" (McEvoy, 1986).

Euro-American Fisheries Management and Mismanagement

Prior to the 1849 Gold Rush, there was little commercial fishing on California's rivers or oceans. The huge influx of settlers in Central California after the start of Gold Rush found a natural world teeming with wild game and fish—of which they quickly took advantage. Hunters, especially those in the market trade, wiped out whole populations of species, including the grizzly bear, pronghorn antelope and tule elk. Fish were hauled easily out of the rivers, caught in gill nets, fyke traps or seines (Reynolds et al., 1990).

During the late 1840s and early 1850s, gold seekers of Italian, Chinese and other nationalities, survived the treacherous land or sea trip to California and made their way to the state's valleys and hills.

Some of these "pioneers" seeking their fortunes in the Golden State turned to commercial fishing. The waters of the rivers began to yield fish for profit. Some have suggested this was the real gold.

In the beginning, gold mining activities and investment offered more profitable outlets for venture, leaving the harvesting end of commercial fishing to poorer immigrants—Chinese, Greeks, Italians, Portuguese and others. The immigrant fishers adapted their Old World skills and marketed their products among those from the same countries and cultures (McEvoy, 1986). At this early stage in commercial fishing, fishers, though bound by cultural ties, worked isolated from others without organization or regulation.

River fishing in the Central Valley almost ended as soon as it had started. By 1852, the sediment from the mines—not over-fishing—nearly destroyed spawning grounds and resting pools on the Sacramento River. Gills clogged with mud impaired the adult salmons' ability to complete their journey upstream. If the fish survived to reach the spawning ground, their eggs were either covered with mud or exposed to air because of low water levels from mining water diversions. The system's tributaries also began losing their salmon to similar fates: the Yuba in 1853, the Mokelumne in 1855 and the Feather and American in 1862 (McEvoy, 1986).

Declines in fish, especially salmon, led to the creation of the State Board of Fish Commissioners in the 1870s. Although the board recognized early on that mining was the major cause of fish disappearance, their attempt to "restore" the fisheries was to establish salmon hatcheries and introduce exotic species, including American shad, striped bass and catfish (McEvoy, 1986).

Protecting the People's Fish

With the concern of increasing numbers of fishers pulling resources from the California rivers unchecked, the state saw compelling reasons to create the State Board of Fish Commissioners in 1870. It was the board's duty to provide for the restoration and preservation of fish. Around this time efforts were started to bring the fisheries under state control, but this was not to be an easy task.

The first fishing statute in 1852, which prohibited the erection of salmon weirs and other obstructions by other than Indians, was ignored by the commercial fishing industry. Other attempts to preserve and protect the fishery, such as the closed season on salmon in 1853, were met with much resistance. Fishing proceeded virtually unchecked and uncontrolled for another 25 years.

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The State Legislature gave the State Board of Fish Commissioners responsibility for protecting terrestrial game animals and fish in 1878. However it was not for another 12 years, with the newly obtained power to hire game wardens (including Jack London patrolling the San Francisco Bay and Delta), that the commissioners possessed both the authority and power to enforce state regulations requiring operators of irrigation ditches to maintain fishways, fish ladders and fish screens, and to enforce fishing restrictions. By 1893, the State Board of Fish Commissioners began taking violators to court.

At the same time that the commission began to collect annual license fees and send its wardens out to inspect fishermen's catches, court actions gave the state additional authority and indeed responsibility for state involvement in the protection of fisheries.

Major early legal decisions included *Ex parte Simon Maier 103 Cal. 476 (1894)* and *Geer v. Connecticut 161 U.S. 519 (1896)*. In 1894, the California supreme court stated in *Ex parte Simon Maier*:

> . . . .the wild game within a state belongs to the people in their collective, sovereign capacity; it is not the subject of private ownership, except in so far as the people may elect to make it so; and they may, if they see fit, absolutely prohibit the taking of it, or any traffic or commerce in it, if deemed necessary for its protection or preservation, or the public good.

Enforcement activity and judicial authority gave the State Board of Fish Commissioners enough clout to begin actively and more effectively regulating the fisheries. An historic early battle was *People v. Truckee Lumber Company 116 Cal. 397 (1897)* in 1897. In this case, the state Supreme Court upheld the regulatory authority of the state to protect fish in the Truckee River against pollution by a lumber mill.

State regulation of right to fish was incorporated into the California Constitution by Article I, Section 25 (1910), giving the Legislature increased power to control fishing. The U.S. Supreme Court's decision in *Hughes v. Oklahoma* 441 U.S. 322 (1979) seems to indicate that under current state and federal law, wildlife is deemed to be incapable of *private* ownership, and that a

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state has a public trust responsibility to manage and protect its wildlife resources for the benefit of the public and the long-term protection of the species.

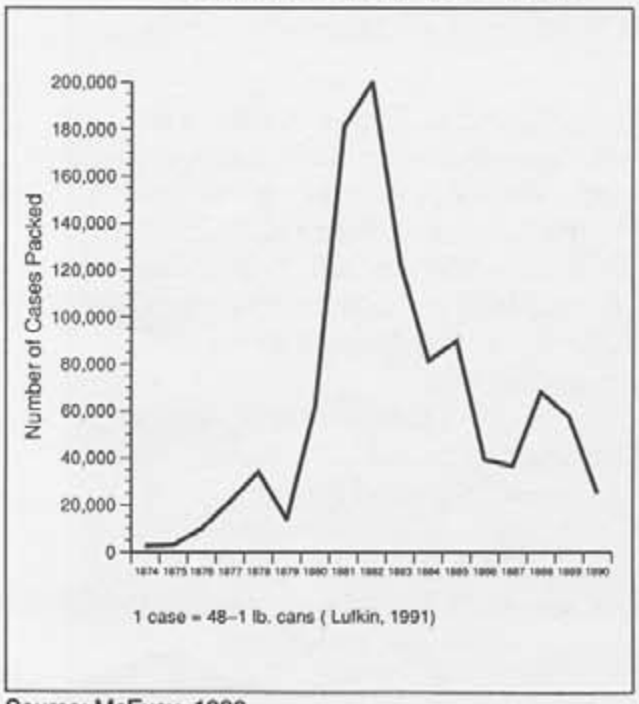
Source: McEvoy, 1986.

Within a decade of the slowdown of the Gold Rush in the late 1860s, the fish habitats which had been so devastated by sedimentation began to recover. Commercial fishing had another growth spurt. The first Central Valley cannery, established in 1864, was joined by another 20 by 1883 (Reynolds et al., 1990). The earliest canneries began processing fish in time to take advantage of a rise in prices in the late 1870s, which coincided with good fish runs. Approximately 10 million pounds of chinook per year were harvested between 1880 and 1883 (McEvoy, 1986).

The bountiful canning harvests lasted four years, the equivalent of one salmon generation, and then the staggering depletion of resources by the fishing industry began to catch up to it in the fall of 1884 (Figure 7). Light runs in that fall caused the profitable fishery to nearly collapse (McEvoy, 1986).

In the following decades surrounding the turn of century, Central Valley and Bay-Delta fisheries fluctuated wildly up and down, varying with the impact of over-harvesting, mining and pollution, as well as natural weather variation—especially important in controlling oceanic conditions (Lufkin, 1991). Meanwhile, conflicts abounded over the government regulation of various fisheries due to competition among immigrant fisher groups. For example, the Chinese, who fished primarily for Bay-Delta resident fish and shrimp, were unjustly blamed for declines in the migratory salmon. In fact, Bay and Delta Chinese fisheries

Figure 7. Sacramento River Salmon Cannery Output, 1874–1890.



Source: McEvoy, 1986

suffered greatly from mining sedimentation and marsh reclamation. (McEvoy, 1986).

Beyond the Sacramento and San Joaquin Rivers

Settlement of the Sierran eastside in the 19th century led to the development of a commercial fishery there for the Lahontan cutthroat trout. The Lahontan cutthroat was a landlocked version of the salmon—it lived and grew in interior lakes, attaining sizes up to 40 pounds (Moyle, 1976) but spawned up the eastside rivers, the Truckee, Carson and Walker (Minshall et al., 1989). Despite the precedent-setting anti-pollution court victory against the Truckee Lumber Company (see "Protecting the People's Fish" above) on the Truckee River, the cutthroat fishery was eventually extinguished due to water diversions, obstructions and introductions of nonnative fish in eastside rivers (Minshall et al., 1989; Moyle, 1976).

The North Coast rivers were fished commercially beginning in 1876. White-owned salmon canneries employed many Native Americans, who supplied fish from their gill nets and worked in the canneries. The new salmon industry became at least a temporary economic salvation to the small Indian populations who had survived the devastation by the first Euro-american settlers (Pierce, 1991a and b).

The New Frontier

Declining Central Valley river fisheries during the period of 1890 to 1920 and the successful use of fishing boats dependent on engine power rather than wind power opened up a new frontier—the Pacific Ocean. Fishermen modified their boats and gear for ocean

Figure 8. Fishing Boats on the Albion River.

work and were once again able to harvest abundant quantities of fish. These fishermen caught many species of fish including tuna, sardines and the river-bred salmon (McEvoy, 1986).

Between the dying river fishery and the newly emerging ocean fishery, California was able to take advantage of plentiful salmon runs from 1901 to 1905 and the state was again a net exporter of salmon. California's inland and ocean salmon harvests became roughly equal and by 1919, the ocean salmon fishery harvests had far surpassed the inland harvests. From 1920 on, the focus of commercial fishing in California was placed on the ocean fisheries, and on fresh fish rather than canned. The last salmon cannery on the Sacramento River closed in 1919 (McEvoy, 1986).

Although this new harvest took place offshore, the river salmon runs were affected by unregulated ocean fishing. Salmon were taken without regard to maturity or their stream of origin. Central Valley river salmon runs and ocean catch continued to rise and fall, depending on the economy and the environmental conditions at the time.

Change for the Klamath

In the Klamath basin, the 1920s brought new rail and road access to the North Coast, which opened up ocean and sport river fishing to the area (McEvoy,1986). Commercial trollers lined up at the mouth of the Klamath to intercept fish before their river migration. A new phenomenon began occurring, huge congregations of recreational salmon fishers at the mouth. Competition between commercial and sportfishers and the Native Americans of the area increased harvesting pressure on the precipitously declining salmon fishery. In 1933, under pressure from sports fishers the state banned commercial fishing in the Klamath River, and local canneries shut down. The commercial closure was aimed at the Indian net fishery, an important industry to local tribal groups. Meanwhile, ocean trollers outside the mouth went unregulated (Pierce, 1991a and b). When the Klamath was closed to commercial fishing many of the Indians who had lost their jobs at the closed canneries continued to attempt to fish both for subsistence and commercially. Over the decades until the 1970s, numerous legal tangles ensued over the dealing with Indian rights to fish. The state made many attempts to control Indian gill netting, but eventually the U.S. Supreme Court upheld the rights of Indians to fish freely on reservation lands (Pierce, 1991a and b).

What Happened to the Habitat

The earliest ups and downs in the state's fisheries from overharvest and habitat losses due to mining sediment and marsh recla-

mation were to be dwarfed by the environmental changes wrought during the post-depression economic boom in the state. By the 1940s, Shasta and Friant dams of the federal Central Valley Project eliminated much of the historic salmon spawning grounds upstream. Diversions and other water management practices degraded habitat downstream. By 1951, after water diversions started in earnest at Friant Dam, the San Joaquin River spring-run salmon was eliminated forever.

As the North Coast region became accessible by roads, the lumber industry began intensive harvesting of the timber on inland watersheds. Lands that had been logged or crisscrossed by dirt roads were vulnerable to erosion during the not-uncommon heavy rainfall years of the North Coast. Logjams and sediment clogged most of the area's salmon and steelhead habitat by the 1960s. Much of the area is still recovering today.

As discussed in elsewhere in this report, aquatic habitats in California have been severely damaged in the past and, unfortunately, continue to be degraded in the present, by a multitude of human activities. Fish habitats have been affected by logging, grazing, agriculture, urbanization and the water development projects built to support them.

Changes in Fishing

As noted above, the Klamath River became famous as early as the 1920s for its sport salmon fishery. Recreational anglers became a powerful economic—and thus political—force. In the 1930s and 1940s recreational fishing began to take over other rivers. By the 1940s the sport fishing for salmon and the introduced striped bass and American shad in the Central Valley was generating three times the economic value of commercial river fishery (McEvoy, 1986). In fact, it was due to complaints of the recreational striped bass anglers that commercial gill-netting on the Sacramento River was finally banned in 1957 (Lufkin, 1991).

Recreational fishing in the ocean became popular in the 1930s, with a rapid growth after World War II. Most ocean "recreational" fishing is done by chartered party boats, a hybrid of commercial and sport activity.

Another change to California fishing was the new federal environmental regulations of the 1970s, e.g. National Environmental Policy Act, the Endangered Species Act and, of great importance to salmon fishing, the Magnuson Fishery Conservation and Management Act of 1976. This act established federal authority over ocean fishing in U.S. waters from three to 200 miles from the shore.

Current Regulatory Status

Under the federal Magnuson Fishery and Conservation Management Act, regional councils were set up to develop fishery man-

agement plans and regulations for ocean fishing, including salmon. California, Oregon, and Washington are governed by the Pacific Fishery Management Council (PFMC). (Technically, management councils only make recommendations for regulation to the U.S. Secretary of Commerce, but these are usually adopted with little or no change.)

The California Fish and Game Commission, with technical advice from the Department of Fish and Game, sets ocean fishing regulations within the three-mile zone of state waters, consistent with the fishery plans developed by the PFMC. The commission also regulates inland fishing except for Indian fishing within a reservation, which is controlled by the Bureau of Indian Affairs (Barsh and Henderson, 1980). State regulations placed on all recreational fishing include possession and size limits, license requirements, gear restrictions, and season and area closures.

With the authority of the state and federal governments to control fishing firmly established, the serious declines of fisheries due to over-exploitation may be past. Current regulation by the PFMC and the state are still not without controversy, however.

With serious problems of projected spawning-run size in the Klamath and Sacramento rivers for chinook, severe cut-backs on ocean harvest have been instituted in recent years. Ocean commercial fishers have complained vociferously, pointing to habitat problems on the rivers caused by water diverters and others as the real culprits. As for the state's fishery management on inland waters, private angling or fish conservation groups are often critical of state regulations. California Trout, Inc., for example, often suggests rules which are more limiting on anglers than those originally recommended by the Department of Fish and Game.

Today there is no longer any allowable commercial fishing of fin fish in California's rivers, except for the small amount of the Native American fishery on the Klamath River. Crayfish are still caught and sold commercially in the Central Valley.

Three Native American tribes—the Hoopas, Yuroks and Karuks—currently fish for anadromous fishes from the Klamath River Basin, mainly using gill-nets. The Hoopa-Yurok Settlement Act (1988) divided the former Hoopa Indian Reservation into two reservations. The act reverted the lower 40 miles of the Klamath River back to Yurok tribal domain. The Yuroks fish from the mouth of the Klamath to the Trinity River. The Hoopa fish on the Trinity River within the Hoopa Valley Reservation, and the Karuk have fishing privileges in a half-mile stretch of the Klamath mainstem below Ishi Pishi Falls, near the Humboldt-Siskiyou county line (Klamath River Basin Fisheries Task Force, 1991).

Only the Yurok sell their fall Chinook salmon catch commercially. The gill net catches of the Yurok were valued at $3 million dollars for 1987, 1988 and 1989 in total (Klamath River Basin Fisheries Task Force, 1991).

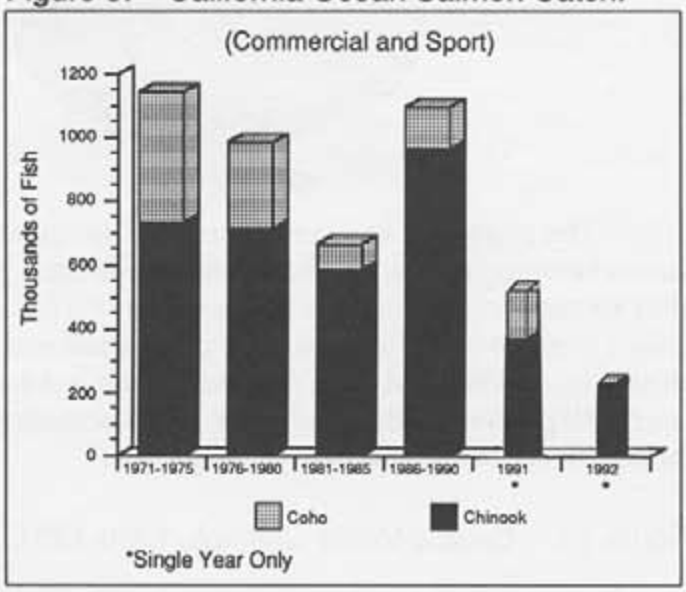
Salmon Fishery Today

In the last 30 years, California ocean salmon harvest has averaged over 7 million pounds a year. Interestingly, the lowest and highest landings for this period were recorded within five years of each other, with 2.4 million pounds in 1983 and 14.7 million pounds in 1988. Trends for the 1990s look bleak as recent landings were only one-half to one-quarter of recent averages (See Figure 9 below).

The ocean salmon fishery contributed about $67 million a year (in 1991 dollars) to the California economy in recent decades. The 1990 and 1991 figures show a decline to $41 million and $34 million per year, respectively (PFMC, 1992).

Chinook dominates the California ocean fishery, averaging about 78 percent of the total ocean catch of about a million fish, but the proportion of coho has been steadily declining (Figure 9). Central Valley chinook alone comprise about 90 percent of the total ocean harvest south of Point Arena, 40 percent of the North Coast harvest, and 40 percent of the Oregon harvest (Reynolds, 1992). In the last few years essentially all of the Central Valley chinook production has been from the Sacramento River system, primarily the fall-run.

Figure 9. California Ocean Salmon Catch.



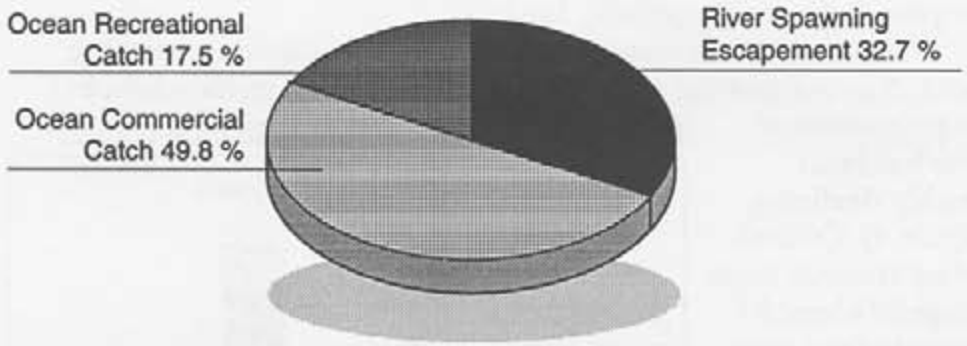
The question of the impact of fishing on salmon stocks is always present and often controversial. The fishery management agencies and the commercial and sport fishers generally claim that the major problem for fish populations is not controlled harvest, but rather, habitat loss. On the other hand, water diverters, polluters and others who may be damaging aquatic habitats point at over-fishing, which is accepted by all to have been a problem for fish populations in the past.

The total ocean catch relative to the river escapement for a particular river system is difficult to ascertain. (See Chapter 4, page 215 for discussion of the term escapement.) Salmon stocks mix up and down the coast as they feed and grow in their ocean stage of life. The PFMC uses several surrogate abundance indexes to estimate the relative ocean harvest impact on river escapement. For the

Central Valley chinook, the ocean catch from the coast south of Point Arena is used to indicate ocean abundance for these stocks.

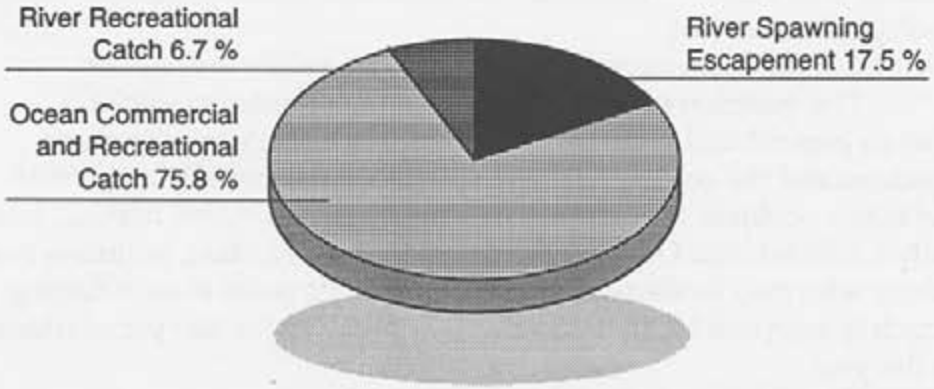
In the last 20 or so years, the combined ocean commercial and sport harvest of Central Valley chinook has been about two times larger than the run size which escaped to the river. Ocean commercial catch has been about three times larger than the sport catch (Figure 10). The California ocean sport salmon fishery is dominated by charter party boats. Private boats take less than a third of the total "recreational" ocean catch.

Figure 10. Central Valley Chinook, 1970-1991.



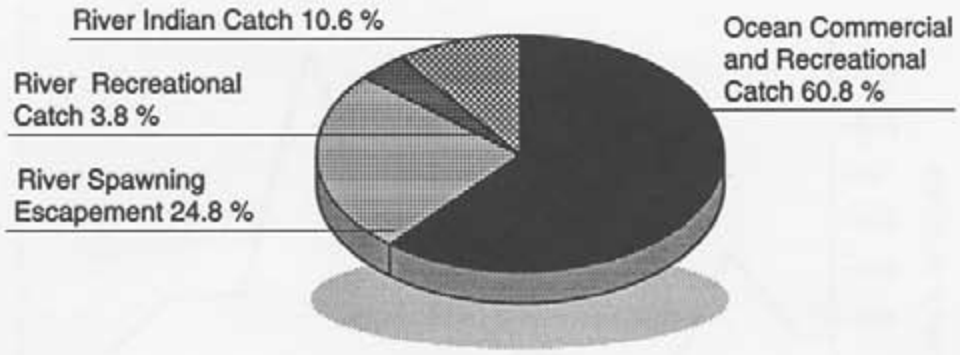
The impact of in river sport catch on spawning escapement varies between rivers, and has varied over time. In the period 1977-1981 recreational fishing for Sacramento fall-run chinook took less than 2 percent of the total in river run (Allan and Hassler, 1986). However, in 1990 and 1991 the sport catch has been much higher, nearly 40 percent of the total river run. Recreational river catch is still far below ocean catch however. (Figure 11).

Figure 11. Central Valley Chinook, 1990-1991.



For the Klamath River, the proportion of ocean catch and river sport catch are both less than that for Central Valley stocks. The Indian gill net fishery takes a significant amount of the total in river population, but it is small compared to recent ocean catch rates (Figure 12).

Figure 12. Klamath River Fall-run Chinook, 1981-1991.



Source for Figures 10, 11 and 12: PFMC, 1992.

Fishing results in a certain amount of mortality for fish that are not landed, and thus not counted. For the Klamath River, non-landed catch mortalities have been estimated by the Klamath River Technical Advisory Team at two percent for river recreational fishing and 8 percent for Indian river net harvest (DFG, 1992b).

Since 1981 both Central Valley and Klamath ocean catches have fluctuated enormously, some of which probably can be explained by variation in oceanic conditions (Figure 13). For example, many scientist believe the 1983 El Niño event had a significant effect on salmon populations, although there is disagreement in the literature. Of greatest concern to fisheries managers is the very recent decline in river runs, starting in 1990, to levels below desired spawning escapement levels, especially on the Klamath (Figure 14). In the Central Valley, 1990-1991 fall-run chinook spawning escapement was two-thirds the size of the previous 20-year average. On the Klamath, 1990 and 1991 fall-run chinook spawning numbers were only one-fourth the average size of runs from 1978-1989.

The ocean commercial fishery in northern California and southern Oregon was closed completely in 1992 to protect the Klamath Run. In central California, ocean commercial and recreational fishing were limited to protect the winter-run Chinook on the Sacramento, as well as Klamath Chinook fall-run, and river fishing seasons and limits have been limited by the state as well (Note: also see Recreational Fishing in this chapter).

Figure 13. Central Valley Chinook Catch—Recent Trends.

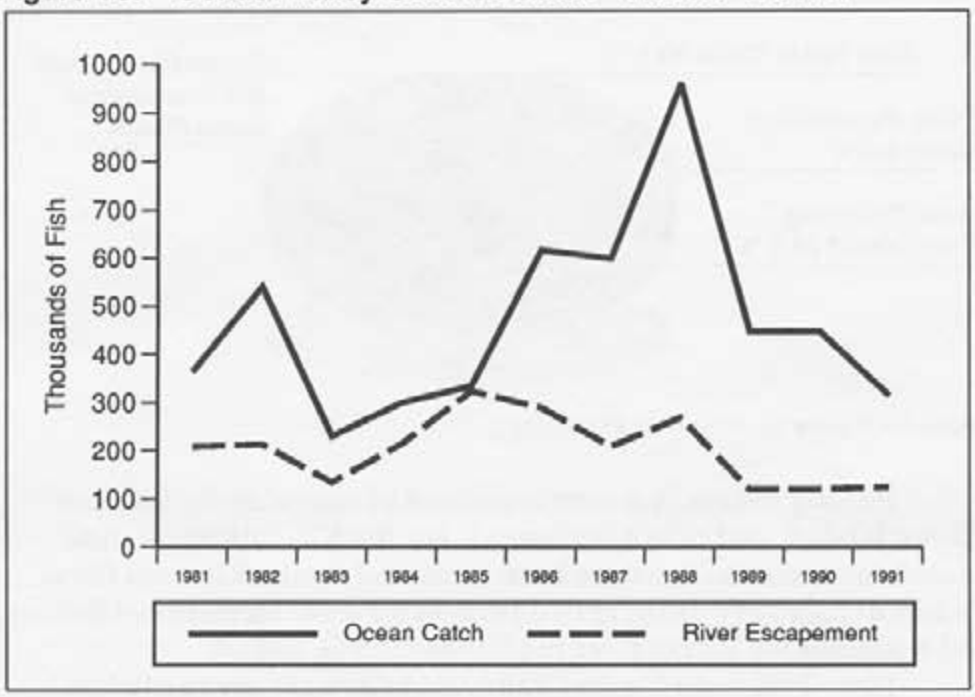
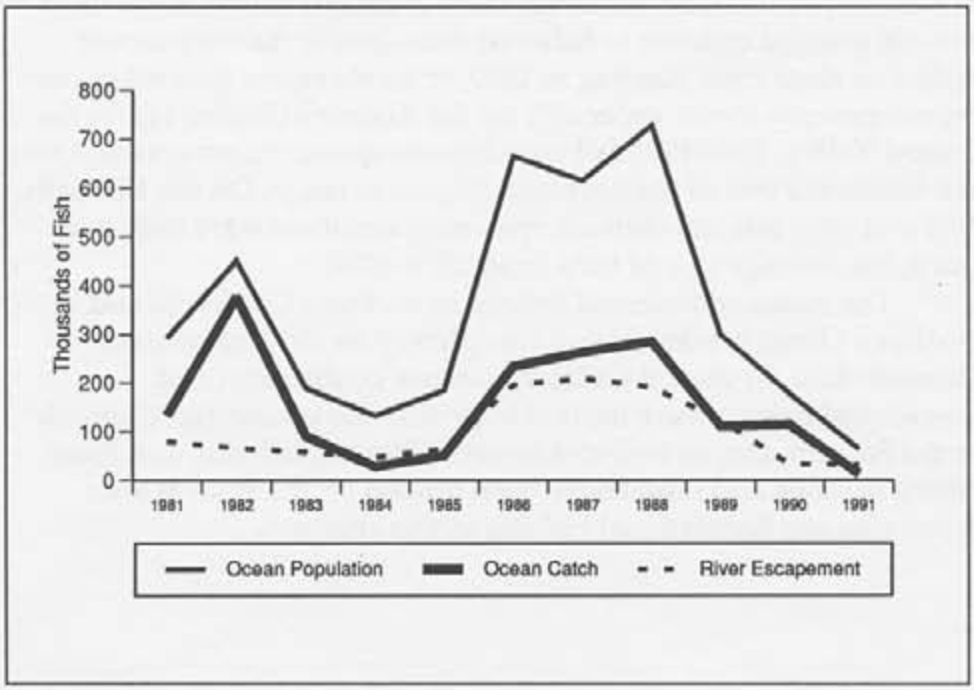


Figure 14. Klamath River Fall-run Chinook Catch—Recent Trends.



Source for Figures 13 and 14: PFMC, 1992.

Navigation

The Steamboat Era

Delta Traffic

The steamboat trade was born, as was so much else in California, of the Gold Rush. John Marshall's 1848, gold discovery propelled the followers of the steamboat *Sitka* into prominence. The Delta became the 19th century equivalent of a freeway. Anything that could float was used to get prospective miners and their camp followers from San Francisco to Sacramento, but it was the steamboats that carried the day.

Large eastern side-wheelers often started their California careers by staggering out of New York or Boston with as much fuel as they could carry, touched at a few ports in the South, the West Indies and Rio de Janeiro to load more coal (or even wood), fought the winds through the Straits of Magellan, and clawed their way up the Pacific Coasts of South America, Mexico and California. Oddly enough, most of them made it in good enough condition to be useful.

Smaller steamers were taken apart, put on windjammers, shipped to San Francisco and assembled on the nearest beach. The *Lady Washington* was "assembled" at Sutter's Embarcadaro and took to the water August 9, 1849. She was the first steamboat on the American River, and she sank on a return trip from Coloma after hitting a snag. Raised later, she became the *Ohio* and kept on going. Also in August of 1849, the *Pioneer*, built at Benicia, began the San Francisco-to-Sacramento run. In October the *Senator*, a famous Boston-to-New Brunswick liner, arrived in San Francisco and started regular service to Sacramento.

Profits were high, and the number of boats and shipping companies kept on growing. Charging $30 for a one-way trip to Sacramento, and $30 a ton for freight, the *Senator* made a monthly profit of $60,000. By the end of 1850 there were 203 vessels working the Sacramento and San Joaquin rivers, as well as the various tributaries.

Competition dropped fares to $1 a trip, and $1 a ton. Races were common, as "the fastest boat on the River" could claim higher prices. Ramming was frequent as well; it was a sure way to get a competitor off the river. To maintain profits and reduce ships "sinking," the major boat owners got together in 1854 and formed the California Steam Navigation Company which held a near monopoly on river traffic through the 1930s.

The era of the big boats ended in 1878. The gold mines, which were responsible for its birth also killed it through the influx of sediment from hydraulic mining. Dry years in the 1850s kept the hydraulic mining debris—sand, mud and tailings—in the upper reaches of the rivers until the floods of 1862, 1875 and 1878 brought down the whole accumulated mass—destroying fishing, covering

agricultural lands, wrecking water supplies and significantly raising the beds of the Feather, American, Bear and Sacramento rivers. For example, Steamboat Slough averaged 12 feet deep in 1853. In 1879 it was only five feet deep, and it was closed to the steamboats. The Sacramento River lost 15 feet of depth. Suisun Bay was virtually filled.

As the number of people and farms grew along the rivers and sloughs, the small, shallow draft steamboat took over where the bigger boats could no longer go. Every slough had its share of landings, and anyone could flag down a steamer almost anywhere along the rivers. Using combinations of the rivers and sloughs the boats could travel over 600 miles on California's inland waterways, from Fresno to Red Bluff, without ever leaving fresh water.

And travel they did, on schedule and off. Even after the railroads bought out the steamship lines they continued to run, for there were cargos that were better shipped by water than by rail, and there were places the rails did not run. Not until paved roads penetrated to the banks of the rivers up and down the valley did the steamers fade away. Some of them went in glory, like during the night of August 28, 1932, when six boats were involved in a fire at Broderick, opposite the City of Sacramento, that almost took all the bridges with them (SLC Shipwreck Database, 1993). But most were simply run up on mud banks and abandoned where they lay—around Government Island in Alameda, off Tiburon or along the shores of Point Richmond.

Colorado Steamer

The Colorado River forming the eastern border of the state, is part of the history of the state's navigable rivers. Surprisingly it too was home to a fleet of steamers. And the headquarters of this operation, Yuma, has not always been exclusively in Arizona; part of it at one time was in San Diego County, and several early steamboats paid their taxes there.

This odd situation came about as follows: Under the terms of the Treaty of Guadalupe Hidalgo, the boundary between the United States and Mexico was set as a line running from a point three marine leagues below the southerly tip of San Diego Bay, easterly to the confluence of the Colorado and Gila rivers. After leaving the Gila, the Colorado does some fancy meandering, to the extent that it actually runs northwest—therefore inside the San Diego-Gila line—for a short distance. Several hundred acres of what is now Yuma lie to the north of the old boundary line. Before there was an Imperial County, Yuma was in San Diego County, the eastern boundary of which was the state border.

In 1851, the year after Fort Yuma was established to protect travelers from the Indians, the U.S. Army let a contract to Captain George A. Johnson to transport freight from San Francisco to this outpost in the desert. The schooner *Sierra Nevada* brought the first load of cargo to the head of the Gulf of California, and also brought the mini-steamer *Uncle Sam*. Little more than a powered launch, she arrived with her first cargo at Yuma in December of 1852.

The next steamboat to appear on the river was the *General Jessup*, a side-wheeler brought to the Gulf sectionally by a coastal windjammer. She was assembled and began running the river in early 1854. She towed barges up from Port Isabel to Yuma and beyond. Now only a memory, Port Isabel once boasted a machine shop and dry dock, and was the point where the schooners unloaded cargos for northern Mexico and the southwestern United States. The dry dock was something unusual in itself, being completely without the usual pumps associated with normal docks. Owing to the fact that there is a tidal range of 22 feet at the head of the Gulf of California, the job of filling and emptying the basin was simple. One merely left the dock gate open when the tide was out and let the waters of the next flood fill the dock. At the same time, one ran the barge or boat into the dock, and got it up on the keel blocks as the water receded. Then the gate was closed, keeping out succeeding tides until the repair job was completed, when the filling process was repeated and the boat serenely paddled away.

Transport began in earnest with the founding of the Colorado Steam Navigation Company in 1853. Not only was there tonnage to carry on the last leg of the voyage from San Francisco to Yuma, but also troops, mining equipment, prospectors and groceries to be taken to points far up the river. It was tricky navigation, for the ceaseless meandering of the river meant that this week's channel might well become next week's sandbar. Wisely, there was not much travel by night, and during the day there was a great deal of sounding with long poles, usually done by the Cocopah Indian deck hands. But good runs were still made, such as the trip by the *Cocopah No. 2* in 1878, from a camp 220 miles up river to Yuma at an average speed of just under 20 miles per hour.

Navigating the Colorado

The Colorado River was first surveyed in 1852 by Lieutenant Derby. But the most famous survey was done six years later, after the river had been in commercial use for some years. In 1858, the government decided to prove once and for all that the river was or was not "available for navigation," despite the growing fleet of steamers that were navigating on the river every day. And it was decided, perhaps because the owners would have billed Uncle Sam $500 per day, not to use one of the boats working the river, but to special-build a vessel. The resulting maritime monstrosity was an iron-hulled affair called the *Explorer*. It is hard to describe this vessel, for she was unlike

Continued on next page.

anything else afloat at the time. She was built in the East, and shipped to Yuma in pieces, where she was reassembled. The *Explorer* was totally open, with a high stern-wheel and pulpit-like arrangement for the pilot far aft, and she was only 50 feet in length.

The *Explorer's* adventures started on January 11, 1858, under the command of Lieutenant Joseph C. Ives. They left Yuma and started up-river. It took them until March 12 to get as far as Black Canyon, now the site of Hoover Dam, some 300 miles upstream. They finally made it to the mouth of the Virgin River in Nevada. For most of the trip, the intrepid explorers were not pleased by their reception by the locals, which was less than respectful. The Native Americans trotted happily along the banks of the river; whenever the *Explorer* found a new mud bank by the simple expedient of getting hung up on it, they would burst into gales of coarse laughter. This seems, from the journals kept by the expedition members, to have gotten on their nerves, as well it might. Not only is it unpleasant at best to be twitted by the locals, but in those days one could never tell when the Indians would tire of the joke, and decide to send an assortment of blunt and sharp objects in one's direction. And it didn't help when, on the return trip, they met one of the regular steamers, the occupants of which seemed as amused as the Indians had been as the surveyors bounced from mud bank to sand bar. Perhaps it was in reaction to being laughed at for so long, but when Lt. Ives returned to civilization he penned an official report stating that "the Colorado is no decent place for navigation."

Source: MacMullen, 1944.

No river steamboat company ever existed for long, or made any amount of money, without someone starting an opposition line, and the Colorado followed the same pattern. Soon the *Esmeralda* was on the river, and the impressive *Mohave* and the *Nina Tilden*. But in 1867, the Colorado Steam Navigation Company bought out all rivals, and operated as a monopoly into the late 1870s.

Callville petered out about 1869. The railroad reached Yuma in 1877. And little Port Isabel had pretty much been abandoned by 1878. The boats still operated north of Yuma for some time, but the backbone of the river business had been broken by the railroads. An irrigation dam across the river ended it once and for all in 1908.

Big Men in Little Boats—The North Coast

Some of the smaller rivers of the North Coast had their vessels as well. The little schooner *Centennial* was built at the Eagle Prairie shipyard for the Eel River trade and operated for nearly a year, running from Rio Dell to Painter's Springs. On a rare ocean trip from Crescent City to the mouth of Klamath River, on April 21, 1877, she capsized in the breakers at the Klamath Bar, and was pounded to pieces on the rocks.

Most of the rivers of the North Coast were too small and too shallow to carry major shipping, but settlements grew up at their mouths and small schooners called regularly. After the wreck of the *Frolic* in 1850, at Pt. Cabrillo on the Mendocino coast, the survivors marched into San Francisco telling "tall tales" of the great redwood forests. A new rush was on, and lumber towns sprang up all along the North Coast. With the lumber trade came more shipping, and the era of the "dog-hole" schooners, a special ship type developed in and for California, was born. So called because "a dog couldn't turn" in the ports and coves used by these intrepid little ships, these schooners were seen on the Albion, Navarro, Smith, Big and Klamath rivers.

Sailing schooners soon gave way to small, steam-powered "lumber schooners," another class of vessels unique to the California coast. Hundreds of these little vessels plied the North Coast and its rivers until the railroad and highway systems worked their way to the coastal towns in the mid 20th century.

Timber Harvest and Grazing

The First Clear-cut

Native Americans and early European settlers to California thrived in an environment of plenty, with neither the need nor ability to over-exploit the land and waters. With the Gold Rush in 1849, the rapidly growing population began exploiting huge amounts of the state's wealth-its natural resources. In addition to mining, grazing and logging forever changed California's watersheds.

Early California timber harvest started slowly. The predominant forest trees near Spanish settlements in the coastal region were redwood, but these were barely touched because the early colonists lacked the equipment to cut down these giants (Adams, 1969). With progress and more infusion of other Euro-american settlers, logging began in a few spots in the redwood region in the 1820s. A trickle of redwood timber in trade soon became a flood as demand for lumber increased with the Gold Rush.

Flat river flood plains with rich alluvial soils and high productivity have always been attractive to human enterprises. With the advent of Euro-american cultures in California, riparian forests and

woodlands experienced immense losses. After the start of the Gold Rush in 1849, Sacramento Valley riparian forests were rapidly cut down for fuelwood (especially for steamships), as well as for fencing and other uses. By 1868, an early writer on California noted that the riparian woods were nearly gone in many areas on the Sacramento River and lower tributaries (Thompson, 1961). Extensive clearing for agriculture followed the Gold Rush period, further decimating much of the Central Valley riparian forests by early this century.

On the North Coast, riparian forests included redwood and Sitka spruce and many riverside forests were among the first areas to be logged for timber production because of their easy accessibility. On the huge fertile delta lands of the Eel, Smith and other rivers of the north, thousands of acres of riparian woodlands and forests were cleared for pasture and other agricultural use (Ray et al., 1984).

In the redwood forests of Central and North Coast California, the speed with which the forests were harvested, as well as the location of the demolition, were functions of the logging technology of the day. In the early- and mid-1800s, trees near the coast and rivers were the first taken because water transport was the only way to get the logs out (Adams, 1969). Near the coast, logs were slid directly downhill and dragged to ocean cliffs, to be loaded on ocean ships. Further inland, logs were dragged to streams and rivers and stockpiled until the channels filled with water with winter storms. Logs were floated downstream, hopefully to waiting ships, but they sometimes escaped to the sea.

Log driving was done on streams and rivers in Del Norte, Humboldt, Mendocino and Santa Cruz counties (Sedell et al., 1991), and was a common practice for moving redwood logs until railroads finally provided other means of transportation in the 1880s. The last big redwood log float was in 1936 on the Big River in Mendocino County (Leydet, 1969). Log rafts were towed down the Klamath River at least until the late 1950s (Felix Smith, pers. comm, 1993).

Sierran pine forests also began to be logged after the start of the Gold Rush, to provide timbers for mining operations (Dasman, 1965). In addition, many logs were driven down the Truckee, Carson and Walker river systems on the eastern Sierra to provide California wood products to Nevada silver mines (Timberman, 1941 *in* Sedell et al., 1991). With the construction of railroads in the late 1800s, Sierran logging could start to supply lowland urban markets in competition with coastal redwood. However, extensive logging was curtailed in the Sierra with the creation of the National Forests, leaving most commercial logging to the North Coast region (Dasman, 1965).

And what logging it was in the north woods—huge stands of ancient redwood forests were cut as fast as possible. Logs were initially moved by teams of oxen (always called bulls by the loggers), dragged along "skid roads" (Adams, 1969). With the advent of mechanized cable logging around the turn of the century, logging

could be done much faster. It also became more damaging to the land, as logs could be pulled every which way, tearing up the soil. Finally, bulldozers, instead of bull teams, were used beginning in the 1930s, further speeding up forest cutting (Leydet, 1969).

Logging on the North Coast continued with the steady growth of the state, until World War II. After the war, the accelerated growth spurred a tremendous burst of logging on the North Coast, this time in the Douglas-fir forests inland of the redwoods. Although no concern was given to environmental harm done by the early logging in the redwoods, many of the forests did grow back in time, at least to a certain extent, due to the sprouting ability of redwood trees. For the most part Douglas fir forests do not reproduce as do the redwood forests. The quick and thoughtless logging in the 1940s to 1960s led to significant watershed and stream damage in the North Coast, compounded by the big floods in 1955-56 and 1964 which hit the region (Downie, 1991).

From the beginning, logging was carried out under a program of just getting the logs out. Little thought was given to protection of other forest values or the health of streams and rivers. California's first forest practices regulations in 1945 addressed protection of the forest productivity for timber production, but little else. By the 1960s a few harvest rules were added to protect streams, but it was not until the modern Z'Berg-Nejedly Forest Practice Act of 1973 that riparian corridor protection was seriously addressed (Bramhall, 1989). Today, regulations by the state on private land and by the federal government on federal lands attempt to avoid environmental harm, but most logging operations, whether by design or by accident, result in some degree of impact to watershed and streams.

Cottonwood forests along the lower Colorado River were also extensively cut for steamship fuel wood, primarily between 1855 and 1890. When steamship demand abated, cottonwood forests began to recover, until a pair of huge floods in 1905 and 1907, which set back plant succession and forest growth. The riparian habitat might still have recovered after these floods, but for the introduction of the invasive salt cedar, or tamarisk tree. Competition by the tamarisk, as well as the numerous dams and channelization projects which eventually tamed the Colorado in this century, all but eliminated natural riparian habitats, which now remain only as isolated fragments (Ohmart et al., 1977).

Grazing

Livestock grazing by sheep and cattle was introduced by Spanish and Mexican colonists in the late 1700s and early 1800s. Huge ranchos spread over the land, fueled by the trade in hides

bringing about one of the most significant ecological changes ever to affect the California landscape. The combination of overgrazing, a series of droughts, and the introduction of exotic Mediterranean annual grasses and weeds led to the almost complete loss of native grasslands.

After the Gold Rush started, livestock numbers in the state increased over ten-fold (CDFFP, 1988). As lowlands were overgrazed, cattle and sheep were moved into foothills and forests. By the late 1880s livestock grazing had invaded almost every corner of the state with devastating results, including soil erosion and the conversion of grasslands into range dominated by poor quality weedy species. Although some government control over public lands was begun in the 1930s, overgrazing impacts to watersheds and streams continued unabated until the environmental movement of the 1970s and 1980s.

Water Development for Farms and Cities

The Franciscan missions, established one day's travel apart in the coastal region, were the first sites of California's earliest intensive agriculture. From the late 1700s to the early 1800s, mission farms produced an amazing abundance and diversity of crops and livestock, including the state's first orange grove at San Gabriel Mission in 1804. Outside the missions, the early settlers were ranchers, more interested in cattle than crops.

Draining and Irrigating the Land

After the gold rush, early settlers—a backwash of disappointed miners and the left over Chinese labor from the railroad projects—took a new look at the Central Valley, beginning in the Delta region. They saw cheap land, and dreamed of levees and farms. The first crude levees were built by hand, basketful by basketful. It was enough to trigger the imagination, however, and unleash Yankee ingenuity. The first land schemes and private development appeared together in the mid-1860s, while the first dredge companies started work just 20 years later. The hand-built levees, the early dredge companies and the first Delta colonies all died in the great floods of the early 1890s.

Power dredges and reclamation districts appeared at the turn of the century, and Delta settlement was here to stay. The modern Delta took shape during the 1910s and 1920s; most islands were drained and put under the plow before the Great Depression took hold. There have been losses since then, but only Frank's Tract, lower Sherman, Little Franks, Big Break and Mildred have flooded permanently (DWR, 1993).

Elsewhere other "reclamation" projects were underway. Fields of wheat prospered in the San Joaquin Valley and Bay Area counties.

Throughout the 1850s and 1860s small towns grew up along the San Joaquin River and its tributaries, and vast tracts of land were put into production. The crops were sent north on the river, and shipped all over the world from ports along the west end of the Delta. Port Costa in Contra Costa County, in particular, became the world's largest wheat shipping port for many years.

In addition to the promise of agriculture, San Joaquin Valley large landholders sought irrigation projects because it could appreciate their land value to as much as $100 an acre in the latter half of the 19th century (Historical Atlas, 1974).

The first irrigation ditches in Kern County were built in 1858 and tapped into the Kern River. Utilizing provisions of the 1850 Swamp Land Act, Miller and Lux (the largest farming conglomerate in California history) controlled a tract of land extending 50 miles along the river equalling 100,000 acres (Historical Atlas, 1974). Through litigation over riparian water rights, an out-of-court settlement, the Miller-Haggin Agreement (1886), divided Kern River water between 31 corporations and 58 individuals and remains in force today (Historical Atlas, 1974).

Diversions of the Kern River began through several canals built in the 1870s and 1880s: the Fresno Canal, the Peoples, Last Chance and Lemore canals irrigated some 85,000 acres in 1882 in Kings, Fresno, Kern and Tulare counties.

The Merced and Tuolumne rivers were the source for the irrigation of Fresno, Madera, Merced and Stanislaus counties. The largest single irrigation system in the state in the 1880s was the 100-mile-long San Joaquin and Kings River Canal starting in Mendota. There were other significant private water companies but the federal Central Valley Project (CVP) of the 1930s ended the large companies.

Agricultural Expansion

Plains and valleys up and down the coast were also developed for agriculture in the last part of the 19th century. Grapes brought from Europe created the famous California wine industry in central-state counties, while orange groves were planted in the south. By the 1890s, irrigated orange groves and vineyards dominated the economy of southern California, and Los Angeles was growing rapidly (Dasman, 1965). A series of dry years at the turn of the century, in combination with urban and agricultural expansion, forced the City of Los Angeles to look far afield for a water supply. William Mulholland found it—in the Owens River hundreds of miles away on the other side of the mountains. The Owens River was tapped by the Los Angeles Aqueduct in 1917.

Meanwhile, other irrigation entrepreneurs had their sights on "making the desert bloom" in the southeastern part of the state. They set about bringing in water from the Colorado River to the arid, yet

fertile lands in the Imperial, Palo Verde and Coachella valleys. In fact, the name "Imperial Valley" was coined as a promotional gimmick at this time to emphasize the great agricultural potential rather than the natural desert condition of this region (California Water Atlas, 1979).

But while water for agriculture appeared to be good business at the time, the water withdrawn to feed the increasing irrigated acreage put the final end to shipping on many rivers. There just was not enough water, even then, for everyone to have all they wanted. The San Joaquin River steamboat traffic went first, and Stockton became the practical head of navigation by the end of the 1890s, except in very wet years.

The Thirsty Cities

Control of a water supply has been the single most important factor in the explosive development of California, as the following brief history illustrates.

The founding of El Pueblo de Nuestra Señora la Reina de Los Angeles de Porciúncula (the town of Our Lady the Queen of Angels of Porciúncula) in 1781 was part of a last-ditch scheme by the king of Spain to colonize California, remotest of outposts, to protect it from seizure by czarist Russians who were as far "south" as Fort Ross. The settlement site was the broad flood plain of the Los Angeles River depicted by contemporaries (Cohen, 1990) as an Eden of cottonwoods, sycamores and ponds filled with fish—an oasis in the parched Southwest.

El Pueblo de Los Angeles was established after the missions to supplement the production of the missions and to reduce the need for importing foodstuffs to support the colony.

In 1784, the provincial governor began awarding grazing lands to retired Mexican Army veterans who had served for a specified time. Subsequent governors gave away nearly all of coastal California from Sonoma County south, and scattered grants in the Sacramento Valley, in a jigsaw puzzle of vast landholdings. Cattle raised on these rancheros provided the income for a life of gracious ease for some of the largest holders, and of bare subsistance for others.

Americans arrived and coveted the paradise. The Republic of Mexico provided an excuse for war and the pueblo was ceded to the United States in 1848. Change came slowly as development gradually spread across the agricultural valleys. By 1876 the Southern Pacific railroad had arrived, followed by the Santa Fe nine years later. Los Angeles was connected across deserts and mountains to the Midwest and Eastern states.

The first artificial water system conceived for a city was not for Los Angeles but rather for San Francisco. Growth as a result of the Gold Rush left the future of the city dependent on imported

water. Plans in 1901 called for dams and reservoirs on the Tuolumne River in the Hetch Hetchy Valley of Yosemite National Park (established by President Lincoln in 1864). Conservationists vigorously opposed the desecration of what some have observed was a valley more beautiful than the Yosemite that remains. They lost. The first water to flow in the 186-mile aqueduct reached San Francisco in 1931. Other major projects included the Pardee Reservoir on the Mokelumne River to bring water to other regions of the Bay Area.

As in the days of the missions, plentiful water was a life-or-death necessity for Los Angeles, the city built in a land of little rain. Completely dependent on imported water, semi-arid Los Angeles, with only .06 percent of the natural stream flow in the state, reached out three times in this century to far away sources.

A rapid increase in Los Angeles' population from 100,000 to 200,000 in the last two decades of the 19th century and several years of below average rain initiated a search for a reliable water source other than the Los Angeles River. The Owens River aqueduct, completed in 1913, was 233 miles long and passed over foothills, through mountains and across the Mojave Desert. Considered a remarkable engineering feat, the 142 tunnels brought 320,000 acre-feet of water annually to Los Angeles. Reservoirs built in Long Valley and Grant Line tapped the Mono Basin in 1940 and extended the original system to 338 miles. The 1940 addition shortened the original route and added 152,000 acre-feet per year.

Because of the manner in which these lands were acquired, the Owens River Valley development engendered open hostility by enraged citizens. (See Chapter 2 for an update on the original water diversions and still-bitter controversy.)

Colorado River water was also diverted through an aqueduct in 1941 to Los Angeles. A branch aqueduct conveys water to the San Diego area. Some of the Colorado diversion was used for irrigating Imperial Valley farmlands beginning in 1901. Settlers sought relief from the river's flooding during 1903 to 1907 by building the All American Canal. This canal takes water just before the river flows into Mexico.

The most auspicious water project—the Central Valley Project (CVP)—grew out of the 1920 proposal of Robert Bradford Marshall, chief hydrographer of the U.S. Geologic Survey. The concept seemed simple: redistribute water from the wet north to the dry south with a series of canals. Barely approved by voters in 1931, bonds were not aggressively marketed, in part because of the depression at that time. The project was taken up by the Roosevelt administration and promoted as a New Deal program to provide water for small farm development in the San Joaquin Valley.

Following the CVP, the State Water Project (SWP) originated as the Feather River Project—a flood control program to "manage" the 3,600-square-mile Feather River watershed. The SWP was touted

as the most elaborate system of water control in the world (Historical Atlas, 1974).

Controlling Rivers–Big Dams and Straight Channels

From the 1870s to 1920s, scientific and technological approaches in government, academia and public policy emerged which drove natural resource management and public works for most of this century. Civil engineers came to dominate the formulation and implementation of resource management policy. Their design and construction of bridges, canals and dams which reorganized natural environments for the benefit of economic growth helped develop the faith of the American public in the capabilities of the engineering profession (Kelley, 1989).

In 1878, the Office of State Engineer was created, with a salary equal to the Governor's. The position was charged with the task of developing solutions to flooding and irrigation problems. It symbolized and emphasized the dominance that "engineering" solutions had come to represent in the name of "efficiency," despite their destructive logging and mining practices (Kelley, 1989).

To many engineers a lake was "more efficient" than a river, and being able to store and release water was viewed as efficiency realized through planning, foresight and conscious purpose. The U.S. Bureau of Reclamation and the Army Corps of Engineers were given responsibility for implementing federal (and state) policy. Water that flowed freely down a river to the sea was considered "wasted" and "dangerous." River management meant the transformation of waste and inefficiency running rampant into planned and directed systems to meet a complex world with efficiency and purpose (Kelley, 1989).

With the benefit of experience, the efficiency of dams has been challenged. Their inefficiencies include increased evaporation, increased seepage, costly effects on the environment and loss of wildlife habitat. Nonetheless, California water policy makers embraced "big dam" building from the early 1920s through the 1970s. O'Shaughnessy Dam on the Toulumne River, was first in 1923 (Figure 15), Hoover Dam, the largest at the time, was built on the Colorado River in 1936. Shasta Dam was next, in 1945, controlling the Sacramento River, and flooding most of the lower Pit River. Then the streams of the Sierra's west slope were tapped, with Pine Flat Dam on the Kings (1954), Friant Dam on the San Joaquin (1942) with Mammoth Pool above that, Oroville Dam on the Feather (1968), New Bullard's Bar on the North Yuba (1970), Don Pedro Dam on the lower Tuolumne (1971), and New Melones Dam, in 1979, on the Stanislaus. The Kings River now ends in a dismal series of dikes, sinks and channels, rather than filling Tulare Lake, once California's largest lake.

There are some 3,700 entities collecting and distributing water to users in California (California Water Atlas, 1979). The majority are

local water districts. The two largest entities are the CVP and the SWP, both consisting of dams, power plants, canals, pipelines and pumps. This assemblage of hardware extends from Plumas to Riverside counties. The SWP alone has 648 miles of aqueducts for water movement (DWR, 1992a). It distributes the runoff from northern and central California to a water-hungry market including agriculture, homes and industry in the Central Valley, Bay and southern metropolitan areas. Four additional major water entities are the Pacific Gas & Electric Company with reservoirs and power plants, San Francisco Water District, East Bay Municipal Water District and the Metropolitan Water District of Southern California, which wholesales water to other Southern California water retailers.

Figure 15. O'Shaughnessy Dam on the Tuolumne River.

Courtesy of *California Trout.*

The U.S. Bureau of Reclamation and state Department of Water Resources (DWR) operate the CVP and SWP, respectively, to meet the water demands of Californians. Additionally, they are responsible for flood control, maintaining minimum habitat, water quality and fish spawning conditions in the Delta and its tributary rivers and streams, maintaining excess reservoir capacity for continuing spring run-off and preventing or reversing salinity encroachment in the Delta. This "plumbing system" must operate for the benefit of all these needs amid a mosaic of other agency jurisdictions, contracts, laws, lawsuits, court decisions and political pressures (Figure 16).

All in all there are about 1,400 federal, state and private dams in California each at least 25 feet high or holding back a minimum or 50 acre-feet of water (DWR 1992b) (Figure 17). One hundred and one of these dams contain 90 percent of the total capacity of all California dams. Including dams on the Colorado River, these dams collectively can impound 42.2 million acre-feet of water. This is enough water to cover all of California south of San Luis Obispo, Kern and San Bernardino counties, to the Mexican border with over a foot of water. This impoundment amount is subject to considerable fluctuation

Figure 16. Water Management Distribution Projects in California.

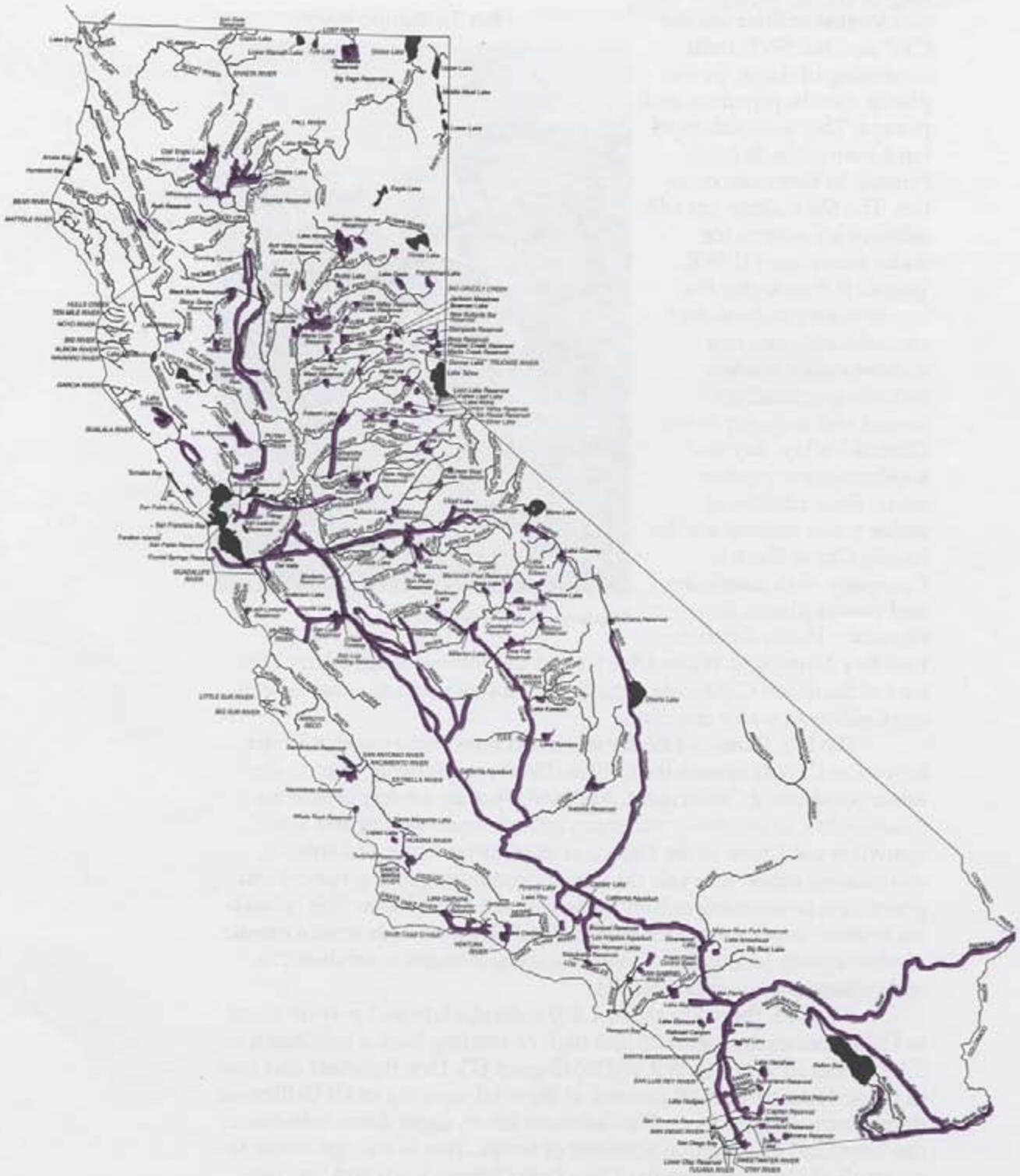


Figure 17. Dams Throughout California.

Source: DWR Division of Dam Safety, 1992.

because, among other reasons, trapped sediments reduce capacity and ultimately end the effective life of the dam. Political factors, such as federal agreements to return most of the Colorado's water to six other states and Mexico, mean that much of the impoundment capacity is not realized. Alternative water management—necessitated by the law, recent legislation and increasing interest in aquatic and riparian habitat restoration—has meant changes in dam operations which in effect "reduces" capacity.

Other public works for water management include flood control. Channelization—the straightening and paving of river channels—has been the traditional engineering solution to flooding. The intent is to move flood waters out of harm's way as quickly as possible. Rivers and streams are lined with concrete or riprap, the bends are taken out, trees and vegetation are removed and revegetation is limited in the general belief that the trees and shrubs will damage flood control structures or impair their functioning.

The history of flood control on the Sacramento River provides a nearly complete picture of the philosophical and technical evolution of approaches for controlling rivers. This effort at control was to fulfill the promise of a bountiful agricultural never before imagined by the settlers. The Sacramento Valley had abundant water, a long warm growing season unlike other parts of the country, rich soils and a ready market. Here the settlers discovered that during the winter and spring, torrential storms from the Pacific and the Sierra melting snowpack filled the Sacramento River and its tributaries and flowed over the river and stream banks to spread water over 100 miles and millions of acres. These periodic floods denied a great agricultural bounty by destroying property, obliterating crops, drowning livestock and creating a great inland sea that took months to drain.

The first efforts at flood control depended on strengthening natural levees where possible. As more miners ended their brief careers in the Gold Rush, more lands were claimed for agriculture in the fertile valley adding more pressure for flood prevention efforts. The farmers' and towns peoples' need to control the Sacramento River and the dramatic effects of hydraulic mining debris filling the riverbed led to the state's most altered environments (Kelley, 1989). The Sacramento Valley today was created from decades of efforts to manage the great river. The valley is filled with farms and growing urban communities in an historic flood plain that historical filled with water for months. This inland sea was home to dense flocks of birds, tule marshes and riparian forests from the Delta to Red Bluff. Today, the flood control program to keep the river confined depends on foothill dams, hundreds of miles of high levees and an intricate system of overflow weirs and bypasses. The half-million acres of marshlands, and million acres of riparian forests have been reduced to remnant fragments.

Figure 18. Channelized Los Angeles River.

Courtesy of Prentiss Williams.

The Sacramento experience was repeated in the Central Valley, the Delta, the Russian River and many other regions. In Southern California the control of floods in the vast flood plains was tackled by the quintessential engineered channel—the Los Angeles River (Figure 18). Its main design function is to convey storm water runoff from its drainage area to the ocean. When water does appear in the concrete trough, it is a hazard since it moves so quickly and the slippery cement walls of the channel makes escape difficult. In southern coastal California, extensive flood control works allowed urban and agricultural development in the flood plain and directly destroyed riparian vegetation, much by the 1920s (Faber et al., 1989).

Channelization has been the standard method of flood control. But this single purpose approach has been questioned in recent years by engineers and the public. The traditional designs may not work as intended and fail during floods. The public has become increasingly dissatisfied with the environmental destruction associated with channelization.

Recreating on Rivers

> *Nature's most important function in recreation is the aspects of performance it provides: beauty, refreshment, serenity. — The Nature of Recreation: A handbook in honor of Frederick Law Olmsted*, 1972.

Run to the Rivers

Californians have flocked to the state's rivers searching for recreation in ever increasing numbers since the end of World War II,

as California's population grew and as the prospering post-war economy granted them more leisure time and money. They met the surviving Native Americans—the first Californians—whose historic use of rivers for food and water and as a place to live remains; they saw evidence of the Europeans' use of the rivers as transportation routes and sources of mineral wealth; and they were stunned at the effect of the singular use of rivers as sources of water for agriculture and the cities and their needs for flood control.

Rivers are recreational and educational assets. Rivers provide a way to break away from the routine of work. Even the enjoyment of other people is increased by the time one spends alone. When alone, people are free to be themselves, to let their imaginations roam, to remember, to dream, or to make plans. Because cities and even the suburbs are more crowded and more dangerous, it seems natural that people seek to be away from their responsibilities and other people. It is understandable that this solitude can be enhanced by the vastness and restfulness of the nature of rivers: coolness of the water and the shade of a tree.

Thus, rivers lend themselves to increasing recreational use because of their beauty, opportunities for activity and the promise of seclusion from the hectic pace of modern life. And rivers are more. Rivers are the best of classrooms: for learning about the functions of rivers; the life of the waters and adjacent riparian habitats; and abuse to rivers and its causes. Recognizing the opportunities of rivers, Californians go to rivers in impressive numbers: Californians in 1992 spent an estimated 2.2 billion visitor days recreating in the out-of-doors on rivers and lakes (DPR, 1992). The overall recreation demand is expected to increase between 42 to 64 percent by the year 2000 (BLM,1990).

As more people use the rivers, awareness of the loss of much of the rivers' amenities grows. Now there is a strong grassroots movement to protect and restore the rivers. The restoration efforts range from retrieving creeks from rock-lined channels to establishing river meander belts based on a more limited historic flood zone. Many of the efforts share the goal of riparian restoration and public access. These common efforts have come together in the California Association of Riparian Parkways (CARP) consisting of elected officials involved in greenway planning.

"Friends of the river" groups have materialized in reaction to the threat of new dams and the results of flood control projects. At the state and federal levels came special legislation to designate parts of some rivers as "Wild and Scenic," and to protect them from further development. The river restoration movement has fostered alternative approaches to river management.

Significance of Recreational River Use

George B. Hartzog, National Park Service director on the 100th anniversary of the National Parks identified the central issue of recreation as one of perspective:

> The real crunch coming in this county is to articulate an environmental ethic to guide corporate and human conduct—and this speaks basically to the issue that man [sic] is part of his environment. The practical problem is that we know how many elk a park can handle ecologically but not how many people.

Recreation benefits California in its economy as well. According to the *California Outdoor Recreation Plan of 1988*, Californians spend more than $30 billion each year on recreation and leisure. Recreation and tourism are California's largest industries. California's rivers draw more of these users than any other location, except for its beaches. It has been noted that "tourism" as such generates no money, but rather the money is generated by the attractions that people travel to see. Rivers are major attractions and should get prime credit for generating tourist dollars (DPR, 1993).

Nearly all facets of California's economy are in some way influenced by or related to recreation and leisure activity (DPR, 1984). Dollars pumped into California's economy from river recreation include not only the direct value of licenses for fishing, registration of boats, equipment purchased and hiring of guides or rafts, but also the value of lodging or campsites, money generated by travel to and from the rivers, and the maintenance and repair of river-related equipment. Estimates of the monies generated from recreational activities around sport fishing and white water rafting can be inferred by the levels of spending associated with the activities. The National Forest Service estimates that the sport fishery resources of the National Forests of California generates $309 million and supports approximately 8,657 jobs through associated expenditures. California anglers provided $34 million from license fees (not including Pacific Ocean licenses) in 1992; this figure was up from 1988 figures by approximately $1,182,000. Boater registration fees were $6,495,000 in 1991/92. Bird watchers pursuing their interests in bird counts and sightings contribute to the economy by spending an estimated $13 per day (Loomis, 1989).

Recreational Uses: Active and Passive

Defining recreation is often more difficult than cataloging it. Recreational activities may be arranged within two general groups: active and passive. Active uses include activities of exertion such as

bicycling, swimming, water-skiing, fishing and boating; while passive activities include picnicking, inner tubing and nature and bird watching. These activities can be done on or around rivers.

However these activities are defined, it is important to have statistical information for planning and development purposes. Park and recreation planners must understand the needs and uses of our rivers. Basic recreation use data is lacking for most public lands adjacent to California rivers. Often this is due to the lack of available funding.

Recreational Fishing

> *Coolidge became an enthusiastic angler, but his skill did not match his keenness. Asked how many trout there were in one of his favorite fishing places, Coolidge replied that there were estimated to be about 45,000. Then he added, "I haven't caught them all yet, but I've intimidated them." The Little Brown Book of Anecdotes,* 1985.

Fishing is an extremely popular outdoor recreational activity in California. Over the last ten years, an average 2.35 million fishing

Figure 19. Shoreline Fishing.

licenses have been sold annually. According to recent surveys by DFG, anglers spent almost 3.4 million hours pursuing fish on the Sacramento, Feather and American rivers in 1991. Statewide surveys of angler preference indicate that anglers fish mostly for trout, followed by black bass, steelhead and salmon (Fletcher and King, 1988).

Sport fishing contributes substantial money to the state's economy. Expenditures for sport fishing (such as travel, food, lodging, gear, guides and rentals) contribute in excess of $2.2 billion to the state annually (Sport Fishing Institute, 1989). The yearly economic

gain from salmon and steelhead recreational fishing on rivers is over $100 million, according to values used by Meyer (1988) in a report to the California Advisory Committee of Salmon and Steelhead.

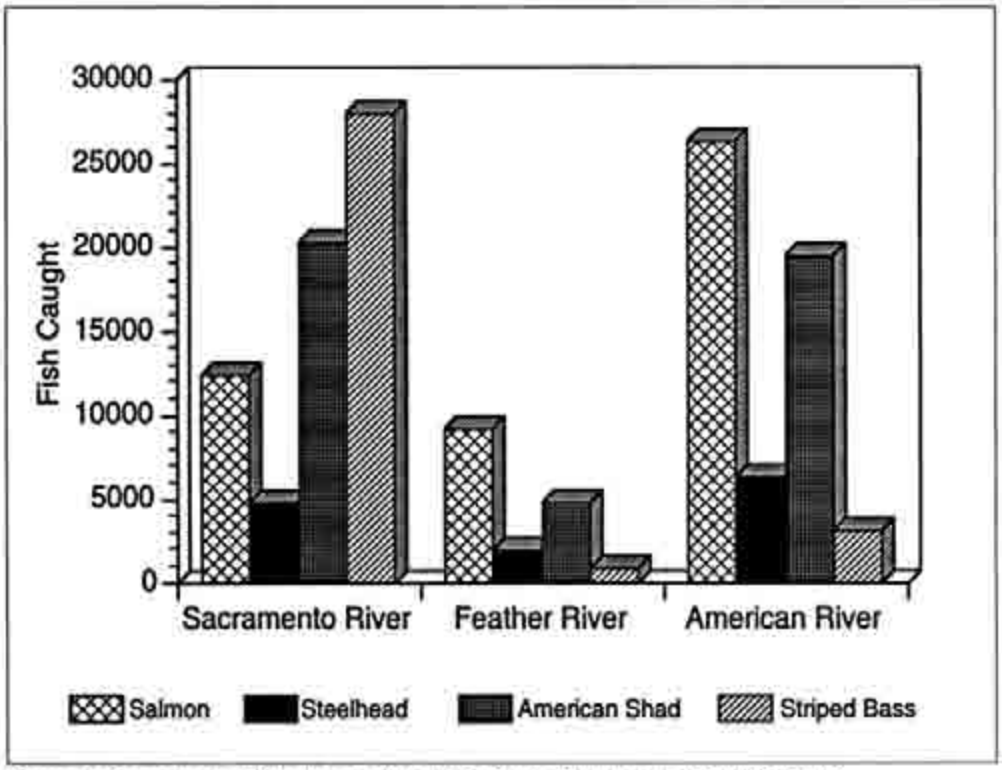
Angler surveys have found that the beauty of the surrounding environment is the most important factor in providing a good fishing experience (Fletcher and King, 1988). This is so despite the loss of fish and increasing crowds which are often blamed for discouraging anglers. This may explain why fishing remains the biggest recreational use of California rivers.

The primary inland fisheries include anadromous fish, resident trout and warm water game fishes. The most significant species of the anadromous group is the salmon family (salmonids). California salmonids commonly sought today are steelhead, chinook (king salmon) and coho (silver salmon).

Sport fishing for steelhead is very popular on North Coast rivers. Steelhead were once found in all coastal rivers and most coastal streams of decent size, but now approximately 90 percent of the state's wild steelhead occur north of San Francisco Bay (DFG, 1991b). The Klamath, Eel and Smith, Trinity, Mad, Russian, Gualala, American, Feather and Upper Sacramento are the most popular steelhead rivers in the state, although the Sacramento run is currently in woeful shape. All of these rivers except the Smith and Gualala have major hatcheries (DFG, 1991a).

Steelhead sport harvest studies have been sporadic over the years. In 1993, the Department of Fish and Game instituted a new steelhead "report card" requirement, following the lead of Oregon and Washington. Steelhead are rarely caught in California's ocean waters, partly because they migrate far out into the Pacific. River fishing for chinook salmon is concentrated in the Sacramento River and tributaries, especially the American River, and in the Klamath system, including its major tributary, the Trinity River. Coho in the past have had large enough runs to support fishing activity in the Klamath and Eel systems, as well as numerous other coastal streams. Recently, native strains of coho spawning within California have declined drastically and the species is now considered to be at risk in California (Moyle and Yoshiyama, 1992). Salmon and steelhead are prized for their tremendous fighting qualities and excellent taste. Even though anadromous salmonids do not actively feed in freshwater, fishers use natural baits and artificial lures to catch them. Fly fishing, spinning, bait casting, drift fishing and plug pulling from drift or power boats, and plunking from the banks are the leading methods used in salmon and steelhead fishing. The total recreational catch of salmon along the Sacramento, American and Feather rivers was estimated to be 47,557 fish in 1991 according to the Sacramento River Angler Survey Estimate Summary (Figure 20). This translates into 705,906 hours or 21 percent of the angler hours spent by fishers along those waterways.

Figure 20. Sacramento River Watershed Angler Fish Counts, 1991.



Source: Sacramento River Angler Survey Estimate Summary, 10/14/92, DFG.

Other important anadromous game fish are the nonnative striped bass and American shad, found primarily in the Sacramento River system and Delta. Today striped bass support an extensive sport fishery in the Sacramento River, Delta, San Francisco Bay, and out into ocean waters. Angling for stripers occurs year-round from private and charter boats, and shore.

For a century after they were first introduced into the state, striped bass populations were abundant, supporting first a commercial, then later a huge recreational fishery. However, the Delta population declined rather suddenly in the 1980s, with adult bass numbers only one-quarter to one-third of levels in the 1960s (DFG, 1991a). This precipitous drop in adults was accompanied by a decline in the Striped Bass Index, a measure of young bass present in the system.

For years, the striped bass has been considered an indicator species for the Bay-Delta Estuary. Department of Fish and Game biologists believe the decline in striped bass is due to a complicated set of human caused influences, the primary being diversions from the Delta and reduced Delta outflows (DFG, 1991a). The Department of Fish and Game has supervised the raising and releasing of young striped bass since 1981, funded by PG&E and DWR for mitigation of their facilities. Planting of striped bass has been recently suspended, due to possible impacts on the Winter-run Chinook in the Delta (DFG, 1992b).